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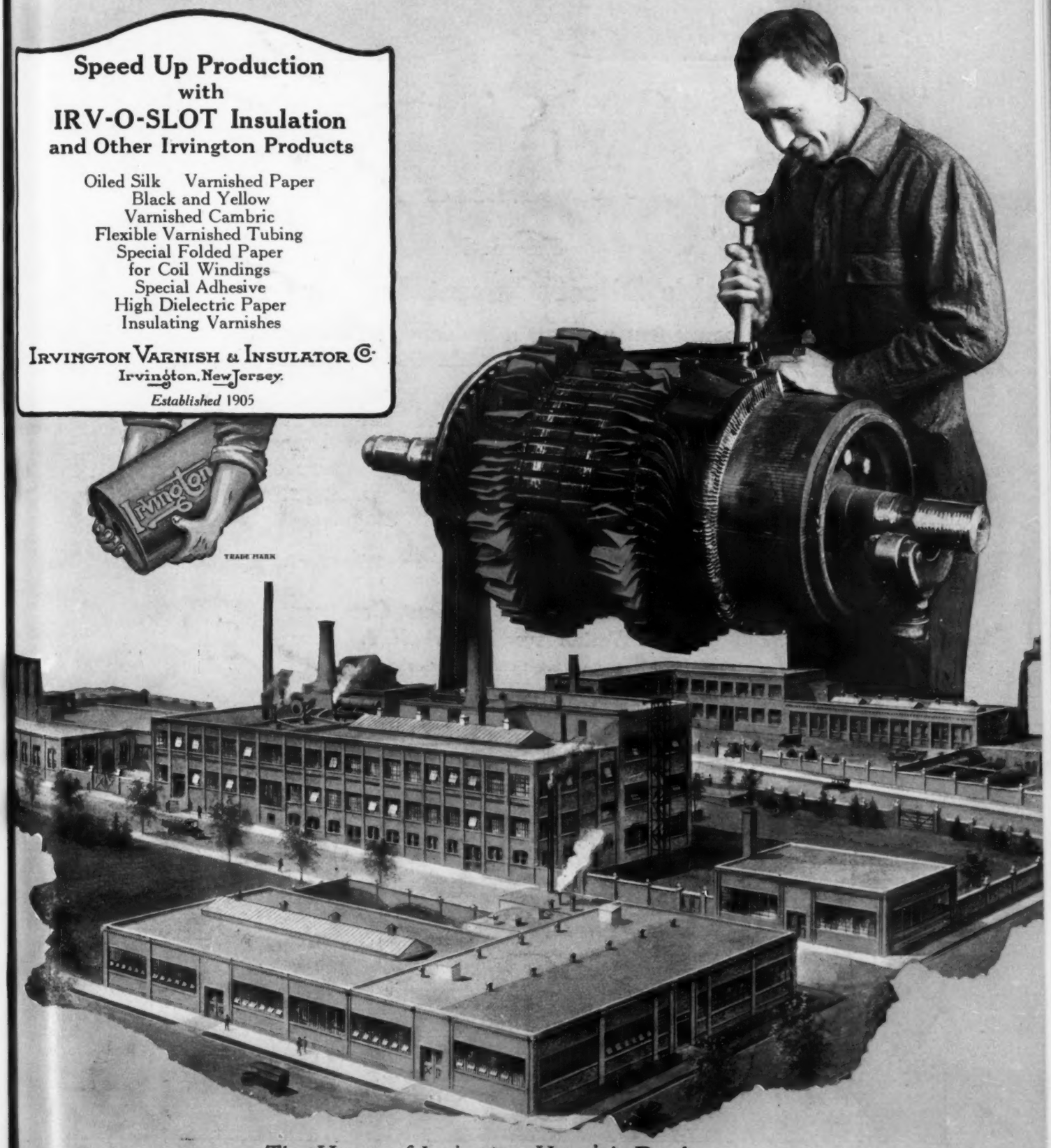

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician
Published by McGraw-Hill Company, Inc.

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Volume 77 New York, Saturday, April 16, 1921 *Number* 16

Moonlight Schedules Are Relics of the Past

POETS wax eloquent over the light of the moon, and we admit that as an example of uniform distribution of low intensity moonlight is most admirable. Nevertheless, the moon's constantly recurring changes and phases have caused it to be taken as a common type of changeableness or fickleness. "Oh, swear not by the moon, the inconstant moon!" pleaded Juliet, and we are moved to paraphrase her plea for those who still adhere to the so-called moonlight schedule and exclaim, "Oh, light not by the moon, the inconstant moon!" In this day, when electric light is so cheap and its advantages are so great, it seems odd that any town should still be moonstruck. Of all public expenditures from taxes that for lighting is the only one which benefits every citizen. For that reason lighting budgets should be preferential and constantly increased within reasonable limits. The slight saving effected by moonlight schedules is so greatly offset by disadvantages as to render the continuance of the practice questionable. Certainly no enterprising town wants light of that kind, and to be as dead as the moon hardly lends distinction.

Revival of Interest in Electric Vehicles

ELECTRIC vehicle shows such as the one held in New York City in February, the one this week in Newark, N. J., and the one scheduled in Chicago during the N. E. L. A. convention are creating a new interest in electric haulage. Central-station companies and manufacturers of electric road vehicles and industrial trucks are joining hands with renewed vigor in the working out of transportation problems on an engineering basis, whether these problems concern delivery on city streets or industrial-material handling at plants and warehouses. To hold an electric vehicle show in Chicago at convention time is particularly fitting, for there, as in New York and Newark, the experiences of users under conditions of service favorable to the vehicle can be reviewed over a long period. Furthermore, during the latter half of the last year the industries of Chicago have shown an increase of 25 per cent in the use of industrial trucks and 15 per cent in electric road trucks, with passenger cars holding their own. Among the large commercial users of electric trucks in the city are two prominent department stores which are holding to the policy of using nothing but these trucks for delivery purposes and increasing their fleets as conditions require. It is claimed that a saving of almost 50 per cent has been made in the cost over gasoline and horse-drawn vehicles. In the industrial plants the economies are even more striking owing to savings in labor costs and the increased speed with which both bulky and small parts are being handled in shop transfer and warehousing operations. The storage battery, which is the vital part of all electric vehicles, has not only stood the test of time but has found a permanent field of usefulness that is as extensive as the industries which the electric vehicle has invaded.

State Development of Water Power Unnecessary

IF PRIVATE utility companies under public regulation were not exercising their stewardship to good account in the development and popularization of needed hydro-electric facilities, there would be some logic in looking to the state to supply the service. Given fair conditions, however, there is little reason to fear that private capital will be found wanting in this field, and long study of the relative merits of public conduct and private conduct of business affairs has led relatively few well-informed engineers and technical executives to champion the former. The attempt sometimes made by politicians to arouse interest in the state development of water powers on the ground that these are being held back from the people by private companies ignores the fact that in many cases a marketable surplus of hydro-electric energy may exist in the very territories on whose soil and over whose streams public ownership propaganda is being spread. In common fairness to the companies that are doing their efficient best to bring their service at reasonable rates alike to the home of the humblest citizen and to the largest industrial plant, let this unworthy imputation be confuted by hard facts in every case where it is utilized as an excuse for socialistic pleas for public power development!

Play Fair with the Telephone Companies

A RECENT case in which a Middle Western utility commission rendered a decision in an action between a telephone company and a power company that seemed to establish a bad precedent contains a lesson central-station executives cannot afford to ignore. The precedent established dealt with the assessment against a power company of costs for changes in ground-return telephone lines. A careful investigation shows that the power company agreed to do certain things as a consideration in obtaining a right-of-way that was already occupied by a rural telephone company. Some guarantees as to service were made that clearly could not be lived up to. The power company failed to carry out its agreements and the matter went to the commission. After trying for nearly two years to settle the case without a formal order, the commission finally used the club that the law provides to bring such companies into line, and a decision was rendered that in

the absence of a proper understanding of the circumstances appears to be contrary to the ultimate public good.

Central-station executives must recognize first that neither telephone nor power service can exist without the use of the public highways. This involves a realization that both the telephone company and the power company must keep their plants up to the best standards that the arts have developed. They must also learn that any infringement of a telephone company's rights to give adequate service will sooner or later show results in abridgment of telephone service and produce a public reaction that must be unfavorable to the power industry.

There is only one safe path, and that lies in the direction of a broad-minded appreciation of the problem of giving the public two types of service in the most efficient way. Co-operation only will make this possible. Such conditions as those that the decision referred to was framed to remedy are inexcusable, and the central-station industry must bring its whole influence to bear in making them impossible. It will be well to remember that, after all, courts and commissions can deal only with facts set before them. With all the desire in the world to act along lines that are fundamentally right and to the point, they can be easily forced to reach their goal in an indirect and destructive manner by ill-judged conduct like that exhibited in this particular case.

New Conception of Generating Plants that Works for Simplification

FOR a long time very large power stations were looked upon as presenting unusual conditions requiring much more elaborate interrelation of parts than stations of modest output. The result of this point of view was enormous and forbidding complication, in which cost, efficiency and safety were often sacrificed to that somewhat elusive quality known as flexibility. Slowly but with increasing results there has developed quite another conception of the case. It is the realization that, substantially, a great power station is merely a small one affected by a multiplying factor and that the same fundamental principles should hold in the design of a station for 250,000 kw. as with one of 25,000 kw. The individual units will be much larger, but each one will represent about the same total proportion of the output and will have the same place in dealing with the questions of load factor, efficiency and safety. There is a realization, too, that in operating a network or ring system it is merely a matter of convenience whether the individual units which make up the equipment are under one roof or several.

It is the logical working out of this more modern and businesslike conception that is conspicuous in the Colfax station. As the article in the current issue says, the station is essentially a group of six moderately rated stations operating in parallel on duplicate high-tension buses. Each 60,000-kva. generator with its equipment is considered as an independent unit feeding into the long mains through its own proper transformers, and no attempt is made to parallel these enormous units with the 12,000-volt low-tension side. By this means a prodigious amount of auxiliary and switching equipment is dispensed with, and each working unit takes its place as an addition not to a station but to the system. In this way, despite the fact that ultimately 300,000 kva. will be concentrated under one roof, the risk of complete paralysis of the station through a short circuit inside the transformers or inside the main switching connections is minimized. Virtually the generators and transformers are considered as an individual unit and housed as such, while the high-tension switching equipment and all accessories are installed in an outdoor switching station. Our readers will do well to study the article itself.

Leadership More Essential Now than Ever Before

WHEN it is realized that the cost of conducting the business of the United States government is six times what it was in 1914 and that more than 50 per cent of individuals and firms conducting business in this country cannot show with any degree of accuracy what it costs to do business from day to day, the opportunity for leadership in the ordinary as well as the large affairs of the present is apparent. No less a business authority than Edward N. Hurley has stated his conclusion, from investigations which he conducted as chairman of the Federal Trade Commission, that among the 250,000 corporations whose affairs were known to that body nineteen out of every twenty-five either earned nothing at all or only a fair-sized salary for one good man. His explanation of the situation is that we have replaced the overcarefulness of the old-time successful business man with overcarelessness and that the present-day business executive has lost his sense of values in dealing with labor, materials and services rendered. Just how to regain this sense of values is the problem that every business man faces at the present moment. While the solution in the various divisions of all industry must be worked out by individual thinking, the correction can only be applied by group action stripped of the selfish ambition to benefit by the lax thinking even of those who have been most responsible for unsatisfactory relations with the public, trade conditions and practices in the past.

In the electrical industry such action already is apparent in the form of the broad-gaged activities of the several groups making up the industry, such as the engineering and central-station group, the jobbers, the contractor-dealers and the associations in the electrical manufacturing group. This group action is again and most fittingly reflected in the recent action of the board of directors to strengthen and broaden the work of the Society for Electrical Development by enlisting the leadership and vision of W. L. Goodwin in that work. Mr. Goodwin has intimately associated himself with the problems of the electrical industry during the past four years as a leader in trade co-operation through his ability to inspire men to action by his common-sense analysis of the fundamentals of the electrical business and his fearless attacks on loose thinking and selfish practices. On the vision of more leaders who possess, as Mr. Goodwin does, the ability to interpret the language and thinking of both the engineering and trade groups, and a closer observance of the ideals to which such leaders aspire, must the future of the electrical industry be built—a business that to those who must supply the materials and services to satisfy the demand for electric energy should reach ten billion dollars in the next four years. It is futile to expect a return to prewar conditions as far as the electrical industry is concerned. The developments of the past five years have

so completely changed conditions and have given such a clear exhibition of the true extent to which electric service can be used that to return to conditions as they were would be more complicated than to push forward the short distance yet to be covered in the industrial readjustment and deflation process which we are now going through. Optimism and confidence equal in stability to that of the electrical industry plus evidence of leadership known to be within that industry is the key to the potential electrical resources which await development.

What Voltages Are Best for Rural Distribution?

WHAT is the distribution voltage limit at which rural service can be given? The discussion of this subject before a recent meeting of the transmission and distribution committee of the Ohio Electric Light Association set forth very clearly the possibilities from a physical standpoint. There is virtually no limit to the transformation ratio that can be used, and so far as experience goes there are no dangers to customers receiving service even with direct transformation from the highest-voltage transmission lines. The real limit is economic, and the question to be answered is what distribution will give the least over-all cost. To answer this involves the consideration of two points, the immediate business and the territory it covers. In the majority of cases the use of 2,300 volts to 6,600 volts will provide the least immediate cost, but any development will show that the voltage is too low, particularly when the business is one covering not only rural territory but the small communities that no rural service line can miss for long. The tendency in too many cases has been to rivet attention on the immediate cost and build lines on which the voltage can be raised only by reconstructing the lines at what is usually an embarrassing cost.

A number of companies that have had to deal with the irrigation problem have found the scheme of building lines for ultimate use at 11 kv. with the star connection a satisfactory method of dodging the most troublesome problems. By using a cross-arm spaced for an 11-kv. four-wire circuit, with insulators for that voltage, a comparatively small increase in original cost is incurred. The line can then be operated originally as a single-phase, 2,300-volt circuit if that voltage only is available. As business increases 6,600-volt transformers can be substituted, and with power coming on, a 6,600-volt, three-phase, delta-connected line can be obtained by running the third wire, and eventually an 11-kv., three-phase, four-wire, star-connected line will develop. The items of expense involved, if the plan is properly carried out, are the substituting of 6,600-volt transformers and protective equipment for 2,300-volt apparatus and the cost of reconnecting the 6,600-volt transformers for star operation. The cost of additional conductors is a capital charge, incurred only as business justifies.

With the lightly loaded rural lines that must be handled 11 kv. works out well from an economic standpoint, and the territory covered, even with fair-sized power loads, is sufficient to justify the investment in transmission lines of higher voltage with step-down stations at intervals feeding into the lower-voltage network. Careful study of the irrigation practice in this respect will be profitable not only to those handling scattered rural service but also to the large companies that must employ both high-voltage and low-voltage distribution. There are a great many advantages, after getting away from the low voltages used in lighting and small power service, in selecting two primary power distribution voltages with a considerable gap between them. One of the advantages lies in the ability, when a fairly high primary distribution voltage is used for heavy power consumers, to control the magnetic effects due to heavy current flows on paralleling lines of other utilities. Several instances in which these effects have been rather marked have been noted lately with heavy power lines on which the lower range of so-called transmission voltages have been employed. This introduces an element in interference that will be of growing importance as load grows and must be considered in selecting distribution voltages on any system where power loads of any size have to be handled.

Selection of Demand Meters

THE maximum demand for power which a customer makes upon an electric supply system and the time of day at which he makes it are often a consideration nearly as important in determining the cost of the power he takes as is the record of the total energy in kilowatt-hours which he consumes. At and near the peak of the daily load curve of the central station a kilowatt-hour may cost much more to generate and deliver than during the idle hours of the night. The customer who demands a large supply of power at the peak hour is a more expensive individual to the central station than if his peak-hour demand were small. Moreover, with human needs and institutions as they are, a customer who makes a large demand is almost sure to present it just at the unfortunate time, *i.e.*, near the peak load.

For the foregoing reasons the demand element has entered into rates for the supply of electrical energy to a very considerable extent, and demand meters have had to be installed in a number of public service systems. The records made by the demand meters are thus of great industrial importance. There are several types of demand meters. Principal among them are the thermal type and the time-interval integration type. The requirements which must be met by a demand meter are peculiar. They must not be too hasty; that is, they must ignore any sudden momentary demand, such as an accidental short circuit might produce before being arrested by a safety fuse. On the other hand, they must not be too tardy and fail to take cognizance of a steady overload which lasts several minutes. Between these opposite limits of Scylla and Charybdis a good demand meter must safely steer.

The subject is discussed from a very practical viewpoint in this number by Willard S. Wilder. He recites the various qualities that a good demand meter should possess from the operating point of view. An ideal instrument would, of course, cost so little that it could be given away as an advertisement; it would be absolutely foolproof and reliable; it would never have to be inspected, and once installed it would never need to be repaired. It must be confessed that between these qualities of an ideal demand meter and those found in the actual instruments there is a distinct difference. However, as time and experience go on we may hope that the difference will be lessened, for the benefit of all concerned.

Bernard Arthur Behrend

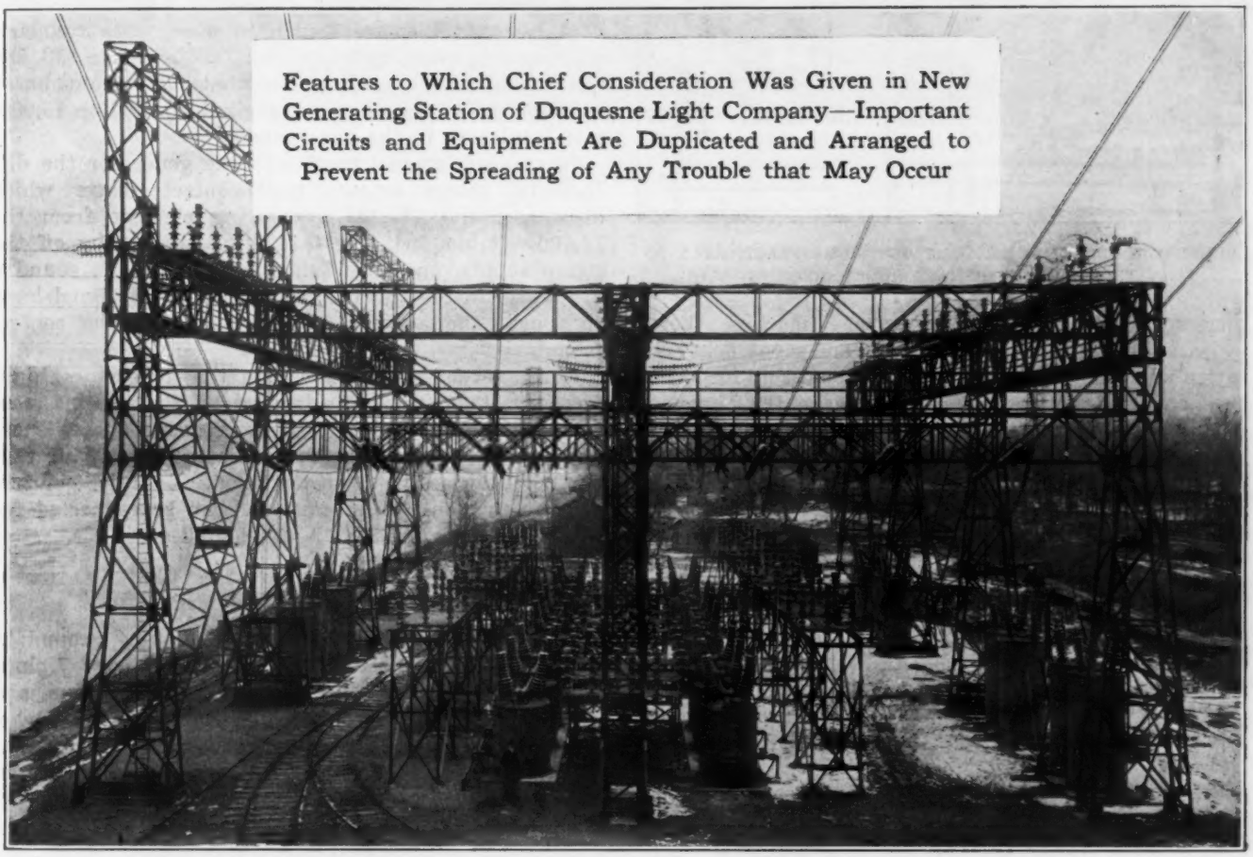
Distinguished as an engineer-scientist and for constructive achievement in the theory and design of alternating-current machinery, in which he has pioneered the way to present-day practice

FOR many years B. A. Behrend has exerted a marked influence on the development of alternating-current machinery both from the manufacturer's and the user's viewpoint. Nearly twenty-five years ago he became conspicuous for advocating high peripheral speeds for waterwheel alternators, for insisting upon the proper voltage margin of generators for low-power-factor loads, rather than extremely close regulation under hypothetical conditions, upon proper kva. to kw. proportioning of prime mover and generator, and upon coal operation under actual rather than theoretical operating conditions. The development in 1902 by Mr. Behrend of cylindrical cores with radial slots for turbo-generators has been widely adopted by both American and European manufacturers. The theory of the induction motor first presented by him in 1895 and the theory of the regulation of alternators, in 1896, have been widely recognized. The circle diagram of the induction motor now virtually in universal use in textbooks and the "leakage coefficient" of this machine employed by designers are fundamentally those first developed and described by Mr. Behrend. The rules of the standards committee of the A. I. E. E. relating to the regulation of alternators now conform to recommendations originally made by him, based upon his theoretical and experimental work.

As consulting engineer Mr. Behrend has been identified with many important engineering projects. One of the most interesting was the linking together at Montreal in 1901 of the power from the Lachine Rapids, Montreal Light, Heat & Power Company and Shawinigan Falls. Mr. Behrend designed the frequency-changing apparatus at Maisonneuve and linked successfully together for the first time three great power stations operated by different types of prime movers. In 1904, when the United States Steel Corporation reconstructed its power plants and installed large gas-engine units at the works of the Illinois Steel Company, American Steel & Wire Company, Carnegie Steel Company and Indiana Steel Company, Mr. Behrend planned the entire electrical installation and worked out the parallel operation of large gas-engine-driven generators without the usual method of trial and error.

Mr. Behrend's first position in this country was with the Bullock Electric Manufacturing Company as chief engineer. Later he was made chief electrical engineer of the Allis-Chalmers Company and established the electrical department of that company. He also served as consulting engineer for Allis-Chalmers Bullock, Ltd., of Montreal. In 1911 he opened his present consulting engineering offices at Boston. For two and a half years previous to that he served as advisory engineer of the Westinghouse Electric & Manufacturing Company in charge of its power engineering department, and he has since been retained by that company in a consulting capacity. The honors which have been conferred upon Mr. Behrend in recognition of his numerous fundamental achievements are mentioned on page 905.

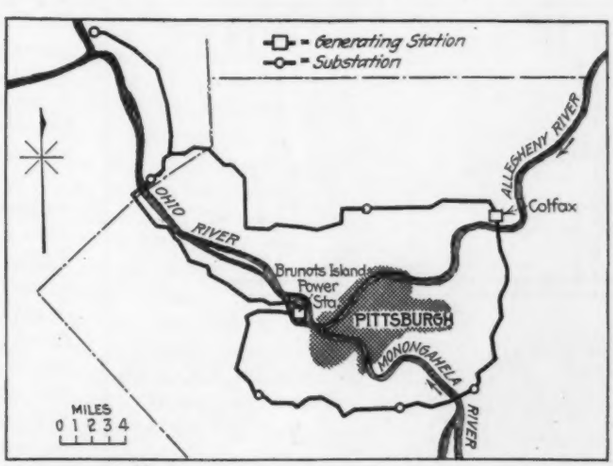
Reliability and Simplicity—Characteristics of New Colfax Station



Features to Which Chief Consideration Was Given in New Generating Station of Duquesne Light Company—Important Circuits and Equipment Are Duplicated and Arranged to Prevent the Spreading of Any Trouble that May Occur

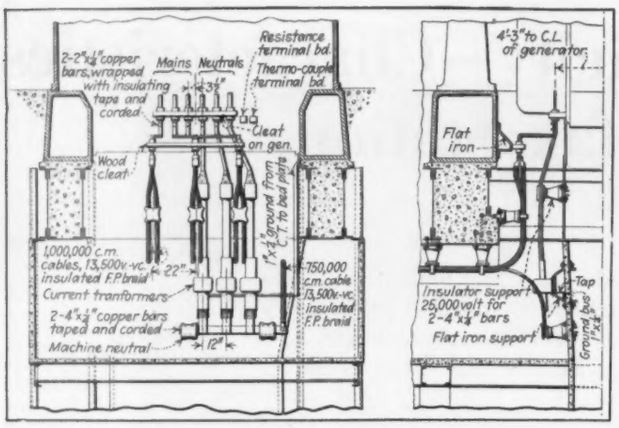
JUST as economy, dependability and simplicity were considered of prime importance in laying out and equipping the mechanical parts* of the Colfax generating station, so were reliability and simplicity regarded as vital features in the electrical end of the plant. In general these requisites were met by designing the plant in such a way that the possibility of trouble would be remote and by providing simple and convenient means for the inspection and repair of apparatus. Reliability is further increased by the duplication of some of the more important circuits and equipment and by an arrangement of apparatus that will reduce the possibility of trouble spreading from one unit to another.

Although equipped with 60,000-kw. generators and designed for an ultimate rating of 300,000 kw., the Colfax station will be essentially a group of six moderately rated stations under one roof operating in parallel on duplicate high-tension buses. By this combination economies are effected in fixed charges and operating costs which would be impossible if the plants were physically separated. The absence of a 12,000-volt multiple connection limits the short-circuit current flowing into any low-tension fault which may be established to such an extent that standard apparatus and methods of construction can be safely employed despite the large amount of generating capacity concentrated within the station. Reliability and simplicity of operation have been greatly increased by the electrical isolation of all main units, auxiliaries, excitation and control and by the relatively small number of electrical circuits and switches required. The three 12,000-volt generating elements of each turbo-



POWER LOOP AROUND PITTSBURGH TO WHICH COLFAX IS CONNECTED

*See first installment of article, ELECTRICAL WORLD, April 2, 1921.



GENERATOR LEADS ARE BROUGHT OUT SO AS PRACTICALLY TO PRECLUDE INTERPHASE SHORT CIRCUITS

generator set are operated as one machine, being switched together on a common bus and given field excitation while stationary. They are brought up to normal frequency and voltage as one generator by the admission of steam to the high-pressure turbine and are synchronized with the high-tension system through the low-tension circuit breaker of the corresponding 70,000-kva. transformer bank. While high-tension operation at present is at 66,000 volts, increase to a higher potential can be made at any time by a simple change in the transformer connections as growth in station capacity and system loads require, since all of the high-tension equipment is designed for 132,000-volt operation.

Among the methods employed to insure reliable service from the generators the following are of particular interest: Method of running the generator leads, the provision of differential relay protection, facilities for extinguishing generator fires, the use of interlocked grounding switches and ground signals, devices for determining the rise of temperature in the windings, the provision of dual drive sets for excitation and the use of a "face-plate" regulator in addition to the ordinary type of vibrating-contact voltage regulator.

Generator connections to the 12,000-volt buses have been insulated more than is usually the case. Each lead is run its entire length in a separate compartment and is made up of two 1,000,000-circ.mil, 13,200-volt insulated cables. These insulated cables are mounted on 25,000-volt insulators in the air ducts and on 15,000-volt insulators in the bus rooms.

In case of internal trouble in the generator the differential relays actuate multi-contact relays which disconnect the affected generating element from the 12,000-volt bus, trip the throttle valve, cutting off the steam supply, open the field circuit breakers, sound a fire alarm in the turbine room and light a signal lamp both over the affected generator and in the control room.

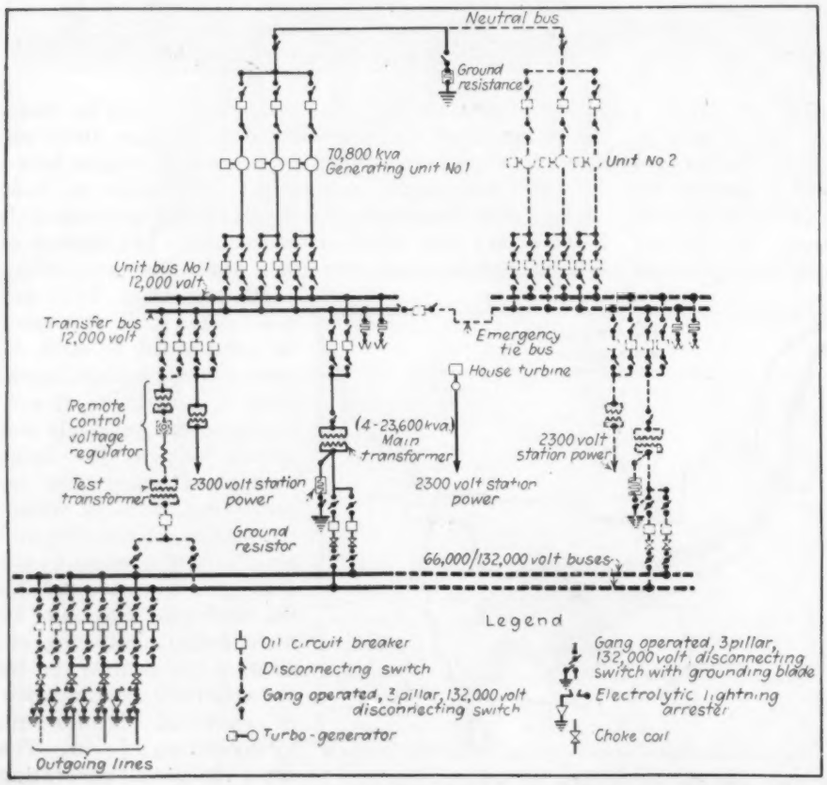
In the event of a fire inside the generators high-pressure steam may be admitted by the turbine-room attendant and the air-duct damper dropped by remote control from the switchboard room to shut off air that would otherwise sustain combustion. Both damper trip and fire-extinguisher steam valve can be connected for automatic operation if it is considered advisable.

INTERLOCKED GROUNDING SWITCHES, TEMPERATURE COILS AND ASSURANCES OF EXCITATION

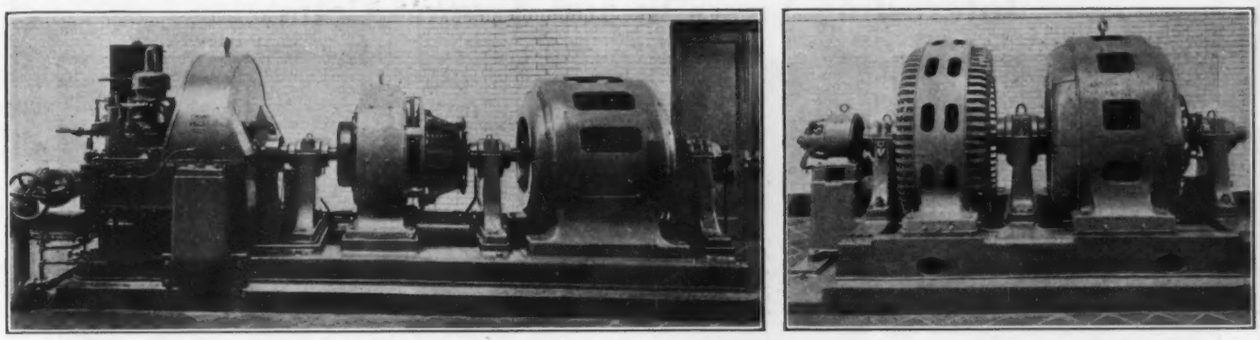
To limit the current that would flow to ground in the case of a complete breakdown a resistor of 7 ohms is installed between the generator neutral bus and ground with interlocked circuit breakers connected between each generator neutral and this bus, so that only one circuit breaker can be closed at a time. To notify the station operator when a ground occurs a green signal lamp and alarm bell in the switchboard room are connected to the secondary of a current transformer in each generator neutral.

Each generator element is equipped with six resistance coils and six thermocouples for temperature measurement, the resistance coils terminating in switchboard indicators and the thermocouples in a potentiometer pedestal, also in the control room. A resistance coil in the air duct makes it possible to determine at any time the rise of the winding temperature above incoming air temperature.

Excitation is supplied by duplex motor-and-turbine driven exciters. Two of these dual-drive sets are installed with the first unit, one to be a spare in the ultimate station. Normal operation of the exciter is by motor drive with a small amount of live steam bled into the turbine casing. In case of motor failure through low voltage or by trip-out, the resultant decrease in exciter speed automatically places the turbine in service as a prime mover, and excitation is maintained without interruption.



ABSENCE OF MULTIPLE CONNECTIONS BETWEEN TURBO-GENERATORS ON 12,000-VOLT BUS REDUCES EFFECT OF SHORT CIRCUITS THAT MAY OCCUR



DUPLEX EXCITERS WITH MOTOR AND TURBINE ON SAME SHAFT; INDUCTION-MOTOR-DRIVEN SYNCHRONOUS GENERATOR USED TO MAINTAIN HEAT BALANCE

Voltage control is secured by either of two methods. One is the usual vibrating regulator with its contacts working across the rheostat of the shunt-wound exciter. In addition, there is a "face-plate" regulator, which is a new development and is believed to possess some features of considerable value. The "face-plate" regulator consists of a voltage-control element arranged to adjust, through relay switches, the position of the motor-operated contact arm of the generator-field rheostat. With this apparatus excitation supply can be taken from a constant-pressure bus with a storage battery floating across it as a reserve if desired. The principal advantage in the use of the "face-plate" regulator is that the device is inherently simple and no extreme variations in generator voltage will result even if the contacts fail to operate properly.

23,600-Kva., Single-Phase Transformers

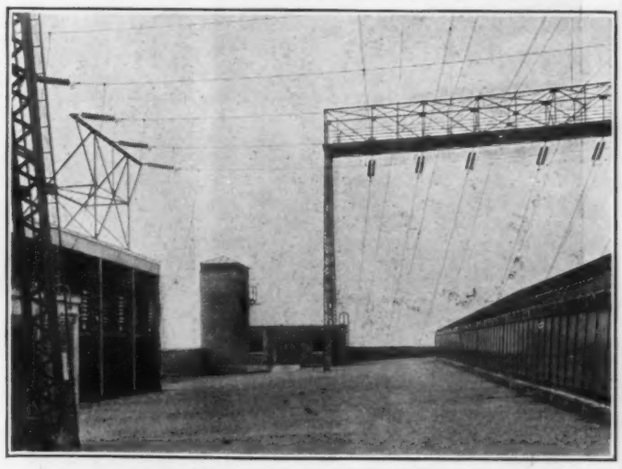
Unusually large single-phase transformers (23,600 kva. each, or 70,000 kva. per bank) are employed, four being installed with the first unit so that one may be used to supplant any single transformer which may be taken out of service. The spare unit stands with all piping connections complete, ready to be quickly connected. To avoid making or breaking the comparatively heavy low-tension connections in time of emergency the four transformers are provided with disconnecting switches on the 12,000-volt side. The spare transformer has selector switch connections between each low-tension terminal and the three supply buses. Normally, the entire six disconnecting switches on the spare unit are in the open position. In case a transformer in the bank fails, its 12,000-volt "disconnects" are opened and selector switches to the corresponding busbars are closed on the spare. On the high-tension side a removable section of copper tubing is taken out at the defective transformer and used to connect the spare to the same high-tension conductor. Water is then turned on the spare. The complete change-over will require only a few minutes. With the bank again in service at full rating, the damaged transformer unit which has been disconnected can be moved into the turbine room on permanent rails, where such repairs as are required can be made with the help of the station crane.

In addition to the usual accessories, two hot-spot temperature indicators are provided with each transformer, one placed near the transformer and the other on the switchboard in the control room. These instruments indicate a temperature equivalent to the highest temperature existing in the copper of the transformer coils at the hottest spot. This result is obtained by placing the thermometer element inside of a heating coil in series with the low-tension circuit. The heating coil is designed to operate at the same unit loss as the main winding and has corresponding insulation.

The usual differential relay protection is provided, and in addition overload relays are employed which are set so that trip-out will occur only in case of a high-tension bus short circuit. The high-voltage neutral of the transformer bank is connected to ground through a resistor of 95 ohms, and a current transformer in this circuit is connected to a curve-drawing meter, an alarm bell and a red signal lamp—all installed in the switchboard room.

Part Indoor and Part Outdoor Installation

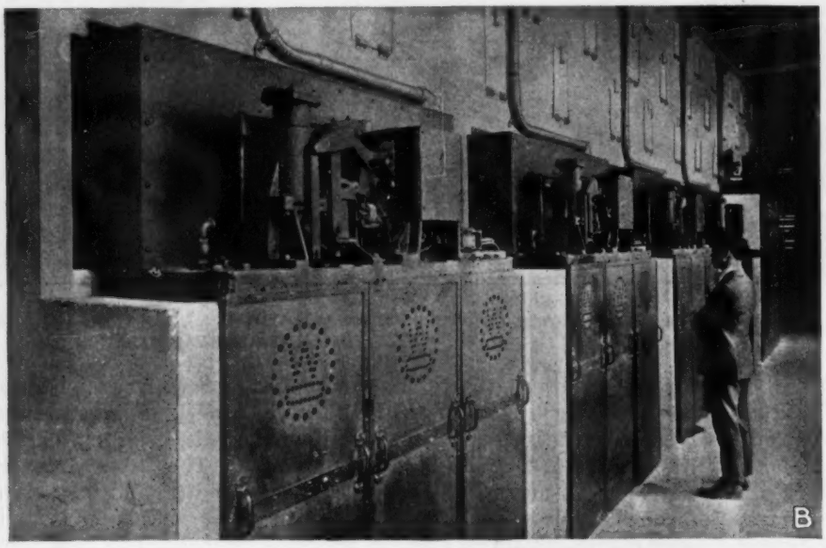
The step-up transformers and the switches required to connect them with their respective generators are placed as close to the generators as possible inside the building. The expense of placing this apparatus as well as the transformer high-tension disconnecting and oil switches in the station was found to be less than that required for an outdoor installation. Consequently such electrical apparatus as is required to place each generator on a high-tension bus and parallel it with others has been placed indoors. The arrangement of this electrical equipment inside the station and the method of carrying the high-tension leads outdoors without using roof bushings are indicated in the accompanying illustration. As shown, the high-tension leads are carried up to duplicate buses on the station roof through high-tension wells. The high-tension roof buses, which run longitudinally, can be extended as the station is extended. From the west end of the power



HIGH-TENSION LEADS EMERGING FROM RISER WELLS AND CONNECTING WITH ROOF BUSES

Interesting Views In and Around Colfax

A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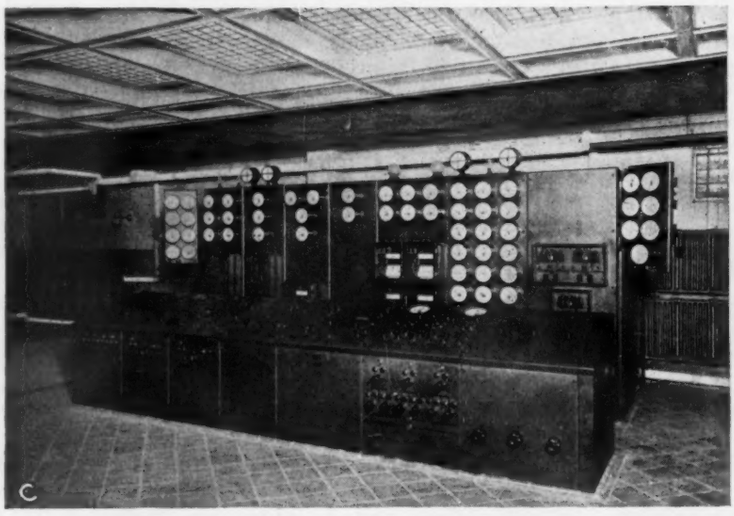
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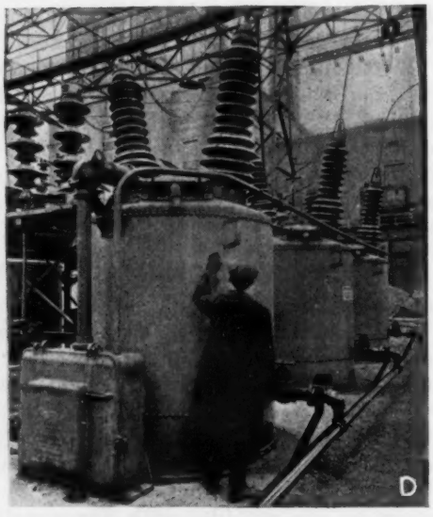
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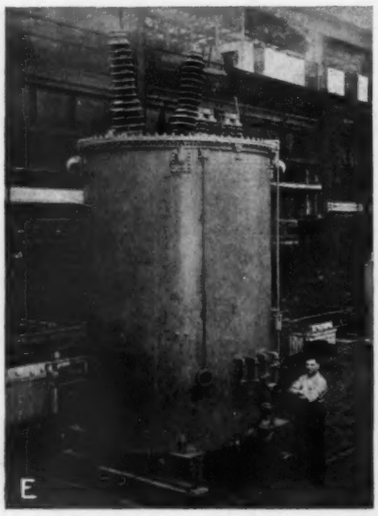
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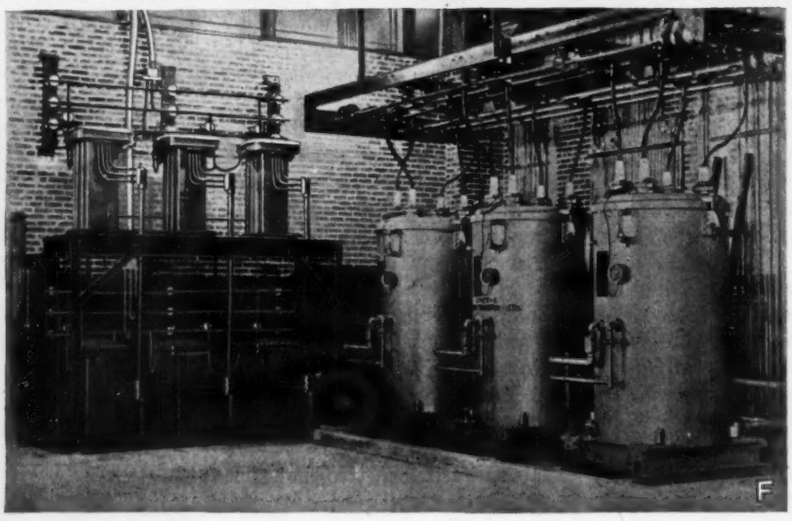

F

A—Typical station-service switch and bus compartment shown in detail on page 869. The lamp signal and push switch over the center of the lower door is to safeguard operators in opening disconnecting switches.

B—12,000-volt oil circuit breakers between generators and unit bus.

C—The bench board is for the control of the main units while the instruments on the vertical board behind are those which must be used in connection with the operations of starting, stopping, etc.

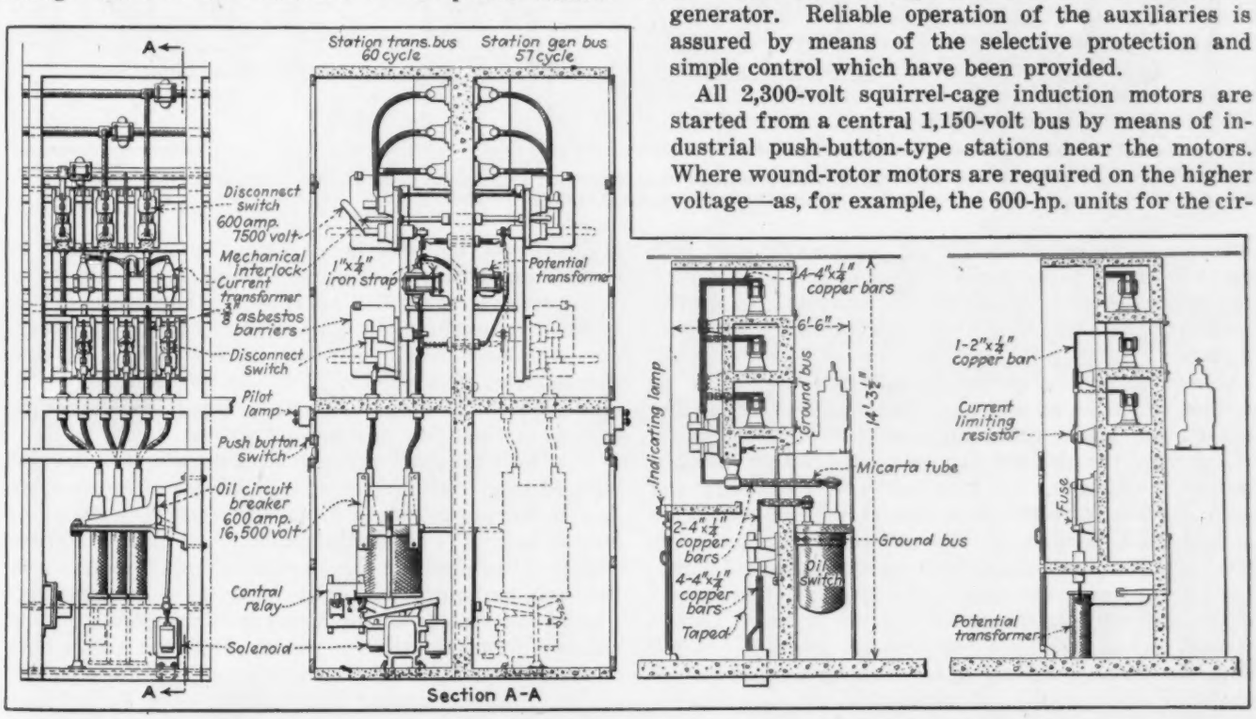
D—One of the 132,000-volt circuit breakers in outdoor station.

E—One of the mammoth 23,600-kva., 11,500/76,210-38,105-volt single-phase transformers.

F—House-service and station-auxiliary transformer installations.

station duplicate high-tension buses are carried down to the outdoor switching station, which at present consists of three feeder bays, although others will be added as required.

The outdoor switching station is particularly interesting because of the simplicity of layout and the provisions for flexible operation and avoidance of interruption of service. As shown by the accompanying illustration, the duplicate high-tension buses extend longitudinally through the outdoor switching station so that taps are easily connected to selector oil switches below and thence through disconnecting switches to the outgoing lines. The oil circuit breakers are operated by remote control from the switchboard and are equipped with bushing-type current transformers. Pipe connections are made from the oil-switch tanks to oil-storage tanks in the basement of the power station.



STATION-SERVICE SWITCH COMPARTMENTS AND 12,000-VOLT CELLS ARE CONSTRUCTED TO INSURE UNINTERRUPTED SERVICE

Gang-operated, three-pillar-type disconnecting switches are used and are operated from the ground level by handles which are equipped with locking devices. Where disconnecting switches are used as transmission-line switches they are provided with gang-operated grounding blades which are mechanically interlocked with the switch-operating mechanism to prevent simultaneous closure.

In order that any disturbance causing a discharge over the horn gaps of the lightning arresters shall not involve adjacent circuits, the lightning arrester horn gaps have been mounted at the top of the structure, above all line conductors and buses. The horns are operated from the ground by mechanical control.

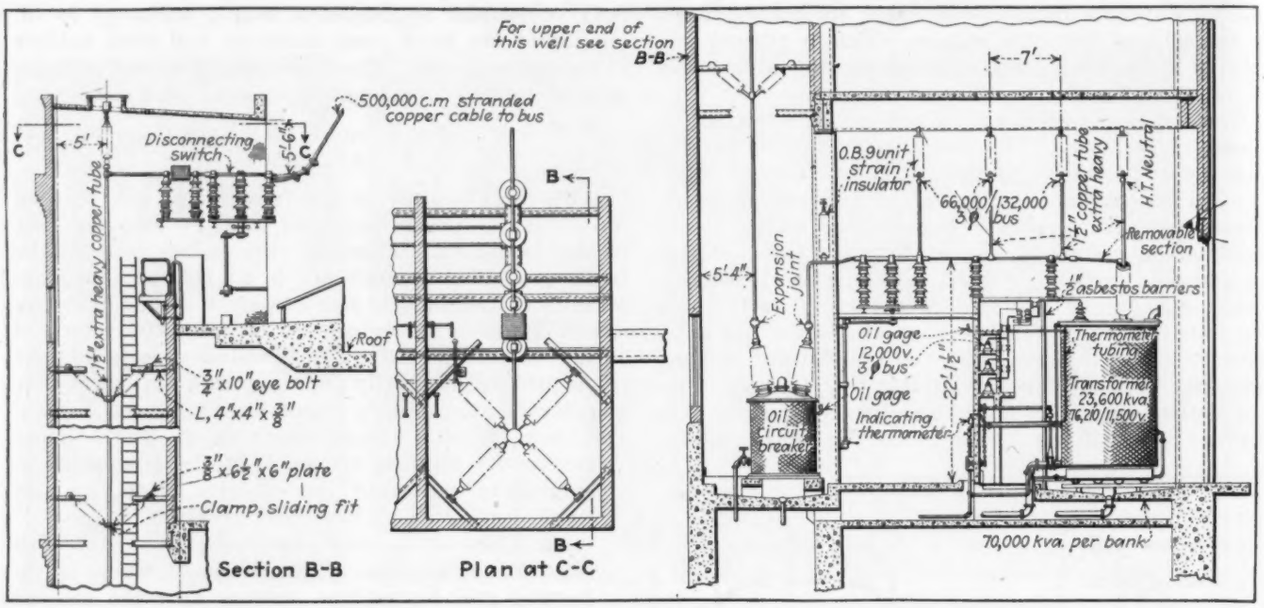
In addition to the usual soldered lugs employed in bus connections, all wire attachments in this outdoor switching station have a mechanical reinforcement in the nature of a U-bolt. Loosening of a soldered joint will thus merely result in increased resistance and discoloration by heating, which will be discovered through periodic inspection before any serious trouble can result. Such inspection has been made particularly convenient by means of railed walkways in all trusses of the main steel structure and steel ladders at convenient points. These features have been included at a relatively insignificant increase in total cost.

SELECTIVE PROTECTION AND SIMPLE CONTROL FOR AUXILIARIES

With the exception of the feed pumps and fans all auxiliaries at Colfax are electrically driven, the heat balance being maintained by varying the load on the house generator, as explained in a previous article regarding the mechanical features of this plant. Motors above 75 hp. in rating are wound for 2,300 volts and smaller motors for 440 volts. Duplicate electrical supply is provided indirectly from the main unit through a step-down station service transformer bank and directly from a 2,300-volt turbo-generator known as the house generator. Reliable operation of the auxiliaries is assured by means of the selective protection and simple control which have been provided.

All 2,300-volt squirrel-cage induction motors are started from a central 1,150-volt bus by means of industrial push-button-type stations near the motors. Where wound-rotor motors are required on the higher voltage—as, for example, the 600-hp. units for the circulating water pumps—a drum-type controller is installed near the motor. In all cases the 2,300-volt and 1,150-volt circuit breakers, instrument transformers and disconnecting switches are installed in compartments in locked bus rooms in the station-service section of the electrical bay. Thus the safety of the installation is increased and the liability of shutdown from accidental interference with live circuits is reduced. Starting and running circuit breakers are electrically interlocked to prevent simultaneous closure, and sequence relays make it impossible to close the running breaker until low voltage has first been applied to the motor through the starting breaker.

Each panel-box circuit from which the 440-volt motors are supplied is connected to the bus at the point of supply through a full automatic oil circuit breaker. In the panel boxes on each motor circuit are fuses of high rating which will fail only in case of short circuit on the supply to the particular motor. At the motors automatic control is provided wherever possible to protect the motor in case of overload. Thus selective protection from the motor to the 440-volt bus is insured.



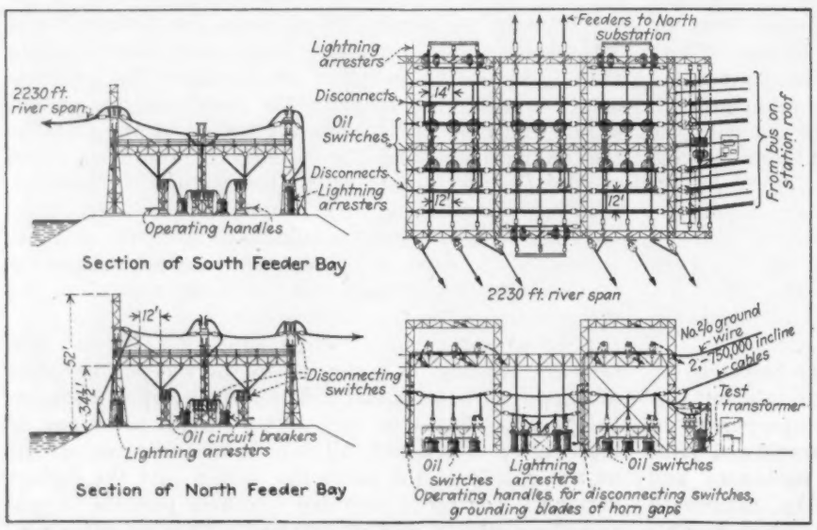
CIRCUITS FROM 70,000-KVA. TRANSFORMER BANKS PASS THROUGH INDOOR OIL CIRCUIT BREAKERS AND THEN UP HIGH-TENSION WELLS TO BUSES ON ROOF

Opening of the automatic circuit breakers or even failure of the fuses in the panel boxes will be an infrequent occurrence, these devices serving merely to localize trouble and protect other station auxiliaries from interruption.

Manual switching of auxiliaries from one supply to another would be an awkward method of changing the load on the house generator and, furthermore, would not provide the desired degree of refinement in temperature adjustment for heat balance. Paralleling the house turbine directly with the main unit would be impracticable because of the difference in characteristics, and more especially because of the hazard introduced by exposing the auxiliary system to disturbances resulting from troubles outside of the station. Consequently, a heat-balance set which consists of an induction motor driving a synchronous generator is employed as a flexible tie between the two generating systems to permit the transfer of a portion of the auxiliary power supply under normal conditions and still prevent the auxiliaries from being subjected to outside disturbances. In practice the load on the heat-balance set is controlled by changing the speed of the house turbine through the remote control of its governor. Guidance in this operation is afforded by a graphic thermometer giving a record of the feed-water temperature. Both the graphic thermometer and the governor control are installed in the control room.

The heat-balance motor-generator set is equipped with reverse power relays so that in case of any serious system trouble causing a drop in frequency on the main station bus to 54 cycles this set will trip out on reverse power, disconnecting the house-turbine system from the main generator bus and leaving the important auxiliaries supplied from the house turbine operating as a separate internal source of power unaffected by the outside disturbance. The only sacrifice will be the economy of heat balance during the period of the disturbance and until such time as the transfer set can again be synchronized with the house turbine and feed-water temperature adjusted. A tie switch is provided between the auxiliary buses and is electrically interlocked with the motor-generator breaker of the heat-balance set. In case of failure of either source of 2,300-volt supply the heat-balance set may be temporarily shut down and the two 2,300-volt buses operated as a unit.

To prevent disconnecting switches being opened or closed when the corresponding oil circuit breaker is closed each set of switches is provided with a protective device including three lamps and a flush-type, double-pole push-button switch. A red lamp indicates a closed circuit breaker, a green lamp that breaker is open and a white lamp that closing circuit to breaker is open. The latter condition is secured by pressing the switch and is indicated by the white lamp.



CONNECTED WITH THE BUSES ON THE STATION ROOF IS THE OUTDOOR SWITCHING STATION SHOWN IN PLAN AND SECTION

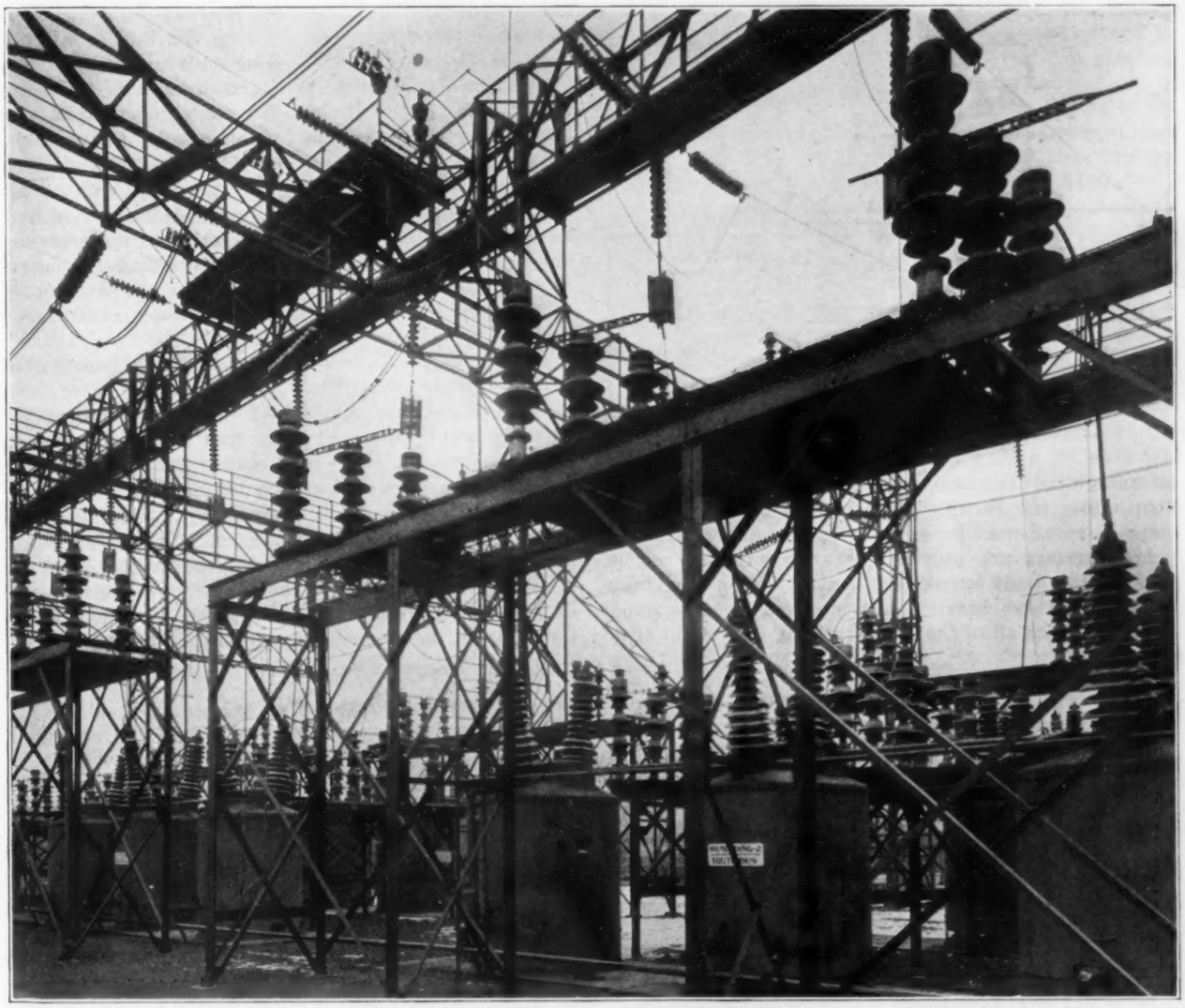
Duplicate control batteries, charging sets and control buses are provided, and all control circuits are supplied from double-throw switches by means of which any circuit may be connected to either bus. Normally, one of the batteries and one of the charging sets are connected to what is known as the operating bus, and all control circuits are connected by means of their selector switches to this bus. This leaves the duplicate bus free for overcharging the reserve storage battery or for serving as an emergency supply in case a ground develops anywhere on the control system.

An emergency lighting system is provided in which all of the emergency lamps receive their supply over independent circuits normally fed with alternating current. If this supply is interrupted, an automatic throw-over switch opens the connection and closes the circuit to the storage-battery bus. As soon as alternating current is again available the lamps are automatically thrown back onto the original source of supply.

Insufficient provision for power-station grounds is the cause of many serious power-station troubles, involving burning out of control and instrument wiring and prolonged delay in resumption of service. Therefore at Colfax seven ground plates have been buried beneath low-water mark and connected to a cable ring bus inside the building. Risers of copper strap make connections with this ring bus to the upper floors of the building, and individual circuits run from these risers to important pieces of apparatus.

To facilitate the routine operation of starting and stopping generating units, signal indicators are installed at the main turbine gage board and in the control room, affording rapid, simple and dependable communication between the members of the operating force. A push-button is operated in conjunction with this signal indicator to sound an air whistle and illuminate a signal lamp in the turbine room, the whistle calling the attention of the attendant to the signal being given and the light indicating the set receiving the signal. A buzzer alarm and lamp at each signal set in the control room correspondingly advise the switchboard operator when signals are being sent from the turbine room.

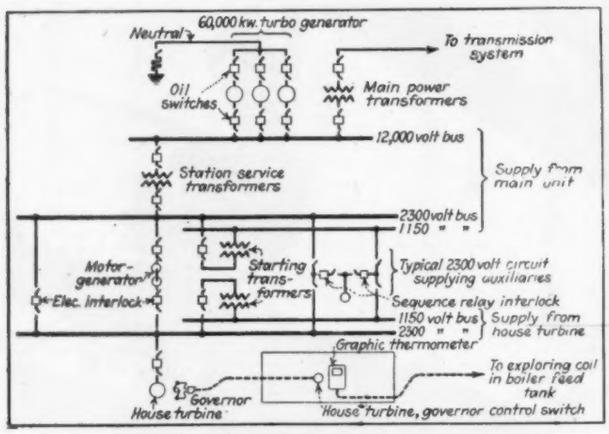
Duplicate private-branch exchange boards with special signals to permit separating commercial and operating calls provide for a maximum amount of telephone conversation with a minimum amount of interference with station operation. These exchanges serve telephones in all parts of the station. Private lines are run to



LADDERS AND PLATFORMS MAKE INSPECTION AND MAINTENANCE CONVENIENT; HORN GAPS ARE INSTALLED ABOVE STRUCTURE SO DISCHARGES WILL NOT INVOLVE ADJACENT CIRCUITS

the system operator's office in the Philadelphia Company's building in Pittsburgh, and as a reserve connection additional lines are leased from the Bell Telephone Company. A special connection equipped with a loud speaker is also provided between the gage board in the turbine room and the switchboard in the control room, so that the control-room operator is not required to use a head set.

The main benchboard is laid out with special attention to facilitating operation, the switches used most frequently being conveniently located and control for all apparatus which is operated simultaneously being grouped at the switchboards. To permit working to



PROVISIONS FOR SERVING STATION AUXILIARIES ASSURE RELIABLE OPERATION

advantage on the control-equipment connections the floor under the benchboard has been dropped so that one may stand erect beneath the control desk. Transite board barriers are provided between adjacent panels, thus confining any burn-out of control wiring to a single panel. On these barriers are mounted slate terminal blocks to which all of the control wiring is brought from equipment mounted on the benchboard. These terminal boards are marked with the conduit number of each individual pipe terminating in the pit below. Each terminal in any group assigned to a given conduit number is marked with the color of the wire which is to be connected to it. This arrangement simplifies the work of originally making switchboard connections and of replacing them in case of routine maintenance work. Spare terminals and conduits are provided for additional circuits in the future.

Because of the absence of the usual low-tension ring bus and the size of the main generating units, it has been necessary to provide some source of variable voltage for building up voltage on transmission circuits for test after work has been done on the line or after a disturbance has occurred causing a circuit outage. For this purpose a testing transformer bank is to be installed as a part of the outdoor switching station. Its low-tension voltage will be capable of adjustment in the switchboard room by means of remote control of a regulator, and its high-tension terminals will be arranged for selective connection to any transmission line. Thus tests can be quickly and conveniently made on any high-tension circuit without disturbing the operation of the generating equipment in the station or interfering with the load carried by other transmission circuits.

In spite of the fact that the station was constructed just at the time that prices of material and labor were at their maximum, the cost of that part of the plant which should be allocated to the first unit was only $105 per kilowatt. This low unit cost is due chiefly to the simplifications in design which have been outlined.

Dwight P. Robinson & Company, Inc., engineers and constructors, who designed and built the Colfax power station, were also responsible for the extension of the transmission system and the design and construction of a number of substations for the Duquesne Light Company in the electric ring around Pittsburgh.

Characteristics of Some of the Electrical Apparatus*

MAIN GENERATORS

Each set to consist of one 1,800-r.p.m. and two 1,200-r.p.m., 23,600-kva., 85-per-cent-power-factor, 60-cycle, 12,000-volt, three-phase elements; 12½ per cent inherent reactance; each unit is star-connected with neutral brought out; 7-ohm resistance in ground circuit.

MAIN TRANSFORMERS

One bank of four 23,600-kva., 11,500/38,100/76,200-volt, single-phase, 60-cycle oil-insulated, water-cooled units to each 60,000-kw. turbine set; 8.2 per cent inherent reactance; low-tension delta, high-tension star; one transformer of each bank is a spare.

STATION AUXILIARIES

House Turbine Generator.—One 2,000-kw., 2,300-volt, three-phase, 60-cycle unit.

Heat-Balance Set.—One 1,100-hp., 2,300-volt, three-phase, 60-cycle, wound-rotor motor driving 750-kw., three-phase, 60-cycle, 900-r.p.m., 2,300-volt synchronous generators.

Duplex Exciters.—Two sets, each consisting of a steam turbine on same shaft with 350-kw., 250-volt direct-current generator and 530-hp., 2,300-volt motor.

Station Service Transformers.—Three 833⅓-kva., 11,500/2,300-volt, single-phase, 60-cycle units, oil-insulated, water-cooled, connected delta-delta.

Auxiliary Power Transformers.—Six 200-kva., 2,300/460-volt units; two banks of three, connected delta-delta.

Station Lighting Transformers.—Six 50-kva., 2,300/230-volt-115-volt units; two banks of three, connected delta-delta.

Motor Generators.—For stokers and clinker grinder supply; two, each consisting of a 325-hp., three-phase, 60-cycle, 2,300-volt motor driving 200-kw., 250-volt direct-current generator.

Battery-Charging Sets.—Two, each consisting of a 25-hp., three-phase, 60-cycle, 440-volt motor driving 15-kw., 125-volt direct-current generator.

Elevator.—Combination passenger and freight, automatic, 2-ton capacity, serving all floors in electrical bay.

Stoker Motors.—Seven 25-hp., 230-volt, variable-speed units.

Clinker-Grinder Motors.—Fourteen 10-hp., 230-volt, variable-speed units.

Circulating Pump Motors.—Three 600-hp., 2,200-volt wound-rotor units.

Air Pump Motors.—Three 100-hp., 2,200-volt units.

Condensate Motors.—Four 100-hp., 2,200-volt units.

STORAGE BATTERIES

For circuit-breaker control and emergency lighting; two batteries of sixty-three cells with E-9 elements having normal capacity of 160 amp.-hr. in E-13 jars.

CIRCUIT BREAKERS

High-Tension Circuits.—Eight electrically operated switches, type G-2, with 132,000-volt rating.

12,000-Volt Circuits.—Ten remote-controlled solenoid-operated switches, types O-2 and CO-2, with 15,000-volt rating.

2,300-Volt Circuits.—Twenty-five electrically operated switches, type B-2, with 16,500-volt rating.

1,150-Volt Circuits.—Nine electrically operated type F-2 circuit breakers, for starting service, rated at 7,500 volts.

LIGHTNING ARRESTERS

Three units, special electrolytic type, for 66,000 volts at the present and 132,000 volts ultimately.

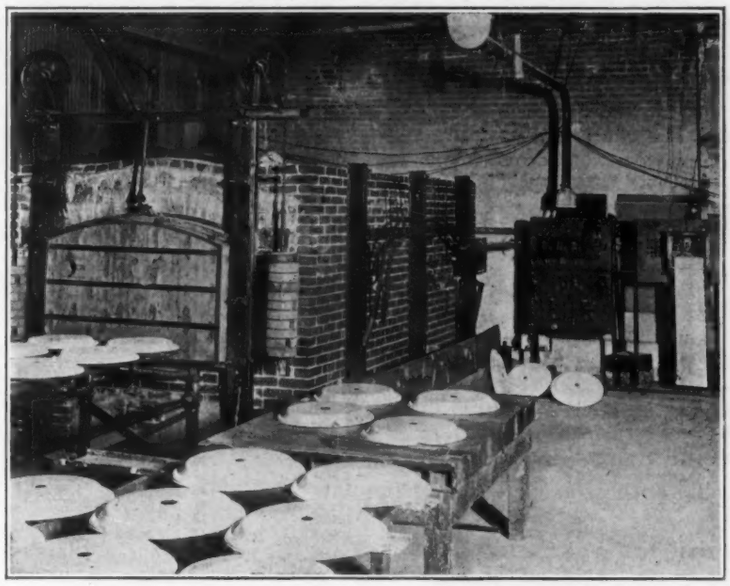
*Except for the storage batteries referred to in the above table virtually all of the electrical equipment listed was furnished by the Westinghouse Electric & Manufacturing Company. The batteries were supplied by the Electric Storage Battery Company. Other equipment which was important but is not listed includes the following: Lighting fixtures—Benjamin Electric Manufacturing Company, Holophane Glass Company; insulators—Ohio Brass Company; bushings—Lapp Insulator Company, Inc., Locke Insulator Manufacturing Company; cable—Standard Underground Cable Company, Simplex Wire & Cable Company, Habirshaw Electric Cable Company and various others; load indicator—Q-P Signal Company; precision instruments—James G. Biddle; conduits—Crouse-Hinds Company; metal boxes—Star Metal Box Company; conduit, conduit and telephone equipment—Western Electric Company; fiber conduit—Fibre Conduit Company; asbestos doors and barriers—Keasby & Madison Company; boiler feed meter—Yarnall-Waring Company; power and lighting cabinets—Krantz Mfg. Co.; recording thermometers—Foxboro Co., Inc.

Electric Heat Raises Enameling Output

New Vitreous Enameling Furnace Facilitates Operations—Control of Process Superior to Old Furnace—Less Defective Enamel Because of Absence of Sulphur Fumes—Operating Data from New Installation

By JAMES W. CARPENTER
Industrial Engineer Union Electric Light & Power Company, St. Louis

A VERY interesting and important application of industrial heat has been made in the construction and operation of what is probably the first commercial installation of an electrical vitreous enamel furnace. This extension of electrical heat from the field of japanning, core baking, oil tempering and annealing to enameling has taken place during the last few months with the installation of a metallic resistor furnace in the enameling shop of the St. Louis Brass Manufacturing Company, manufacturer of a lighting fixture requiring vitreous enamel parts.



VITREOUS ENAMEL FURNACE INCREASES THE NUMBER OF CHARGES AND THE WEIGHT OF EACH CHARGE THAT CAN BE HANDLED DURING WORKING HOURS

This electric furnace installation has demonstrated fully that electric heat is applicable to the work of vitreous enameling, and the owners of this particular unit have been satisfied not only with the speed of operation obtainable, the ease with which the furnace can be placed upon part-time operation and the large amount of ware that can be placed on each charge, but they have been most highly gratified with the very fine grade of enameling which has resulted and which is attributed chiefly to the constant, even and readily controlled heat. This furnace was installed in the hope of obtaining such results and because of the general dissatisfaction with the older types of enameling furnaces.

Previous experience with coal, oil and gas furnaces had demonstrated that the temperature of 1,700 deg. Fahr. (927 deg. C.) could not be obtained or maintained constantly without the greatest of care, and repeated shutdown and loss of production resulting from sagging or breaking muffles, as well as defective enamel due to sulphur fumes or other forms of objectionable heat, caused the company to seek a new method of heating. The electric furnace is considerably higher in first cost and in operating cost. However, this furnace permits from 30 to 50 per cent more charges per hour than were obtained with coal, oil or gas furnaces and at least 25 per cent greater weight for each charge. In addition to this, there are virtually no maintenance expense and no loss of production through shutdowns or repairs. Owing to the increased rate of production the furnace will now handle 900 lb. (408 kg.) of enamel ware in one hour, and this greater output, together with the greatly reduced cost of furnace upkeep, means that with electrical energy costing 1¼ cents per kilowatt-hour enameling can be done by electrical heat at less cost than with any other type of furnace.

The new furnace is of the box type and similar in design and construction to the units used in heat treating and annealing. It measures approximately 12 ft. 11 in. (3.9 m.) in depth by 7 ft. 8 in. (2.43 m.) in width and 7 ft. 4 in. (2.13 m.) in height in over-all dimensions, while the actual space for enameling work is 4 ft. (1.2 m.) wide by 2 ft. (61 cm.) high by 10 ft. (3 m.) deep. The roof of the furnace is curved somewhat so that the actual height of the furnace varies between 26 in. (66 cm.) at the side and 30 in. (76 cm.) in the center.

The heat is obtained from ribbon "Nichrome" wire arranged in a lattice-like construction on the sides, both top and bottom, of the furnace and supported on special hanger bricks which are incorporated in the inner walls of the furnace. The "Nichrome" winding on the lower sides is double, while that on the upper sides is single except for about 22 in. (56 cm.) in back of the door, where a double winding provides for the losses occasioned by the opening and closing of the door. There are six "Nichrome" elements used in making up the complete heating equipment, and they are connected to the electrical supply by special outlets placed in the walls of the furnace. The "Nichrome" wire is approximately ⅝ in. (16 mm.) wide and 0.05 in. (1.27 mm.) thick, and careful test made on this resistance wire after sixty days' operation has shown that there has been no apparent physical or electrical change. As this wire is to be operated at a temperature not over 1,800 deg. Fahr. (982 deg. C.), suitable fuses are installed in the furnace connections to protect the

elements from destruction by temperatures exceeding their normal rating.

The furnace brickwork is built up of three courses. First there is a 4-in. (10-cm.) course of common firebrick in which the special hanger brick for the support of the "Nichrome" winding is laid as a single row. Next comes the 9-in. (23-cm.) course of special insulator brick and then a 4-in. (10-cm.) course of common red brick. There is not a great deal of radiation through the walls of the furnace, but it is probable that the entire furnace will be covered with a coat of asbestos further to reduce this heat loss. The door of the furnace is about 4½ ft. (1.4 m.) wide by 3 ft. (0.9 m.) high and is made of special insulation brick in a steel frame. Special monel-metal racks have been adopted as the standard for supporting the metal to be enameled, as these lighter racks reduce the area and weight of metal entering the furnace and give much longer service than the ordinary iron racks. The ribbon winding for the furnace has a maximum rating of 150 kw. and is operated on 230-volt, three-phase, 60-cycle current. The record of the operating temperature as well as the control of the electrical current is obtained by two thermocouples connected through the walls of the furnace, one of them measuring the temperature of the air in the furnace and the other the temperature of the winding. Connections are made to an automatic control panel installed at the rear of the furnace. This panel holds contactors and automatic switches which provide for the automatic control of the furnace, and these are operated by means of the Leeds-Northrup automatic two-point temperature recorder and controller. This equipment gives a recording chart showing the temperatures of both the ribbon and the air and includes a simple adjustment for varying the operating temperature.

The accompanying illustration shows the control panel and the temperature recorder and the connections on one side of the furnace. The heavy cables from switchboard to furnace are to be inclosed in conduit.

The electrical equipment and hanger brick supporting the "Nichrome" winding, as well as the layout and technical supervision, were supplied by the General Electric Company. The furnace was constructed by the St. Louis Brass Manufacturing Company, and the wiring and the electrical connections were made by the Union Electric Light & Power Company of St. Louis.

At the time of the purchase of the furnace guarantees were given that it would bake 8 lb. (3.6 kg.) of material per kilowatt-hour, this weight to include the racks on the basis of half of the total weight, with the understanding that the guarantee covered the operation of the furnace at the full capacity of 1,200 lb. (543 kg.) of material per hour, including the racks. Similarly, the electrical heating elements were guaranteed to maintain a temperature of 1,700 deg. Fahr. (927 deg. C.) under an operating cycle of three minutes and forty seconds, during which time the door would be opened ten seconds for loading and ten seconds for unloading with an average baking time of three minutes and twenty seconds. Furthermore, the heating elements were not to exceed a maximum demand of 150 kw. The temperature rating and demand guarantees were satisfactorily met, while the production of the furnace in pounds of material per kilowatt-hour was greatly exceeded and will be further improved upon as greater experience is obtained in the operation of this type of furnace. Moreover, the operating cycle has been reduced from the guarantee of three minutes and forty seconds to one minute and fifty seconds.

OPERATING DATA ON NEW VITREOUS ENAMELING ELECTRIC FURNACE IN THE PLANT OF THE ST. LOUIS BRASS MANUFACTURING COMPANY

Pieces of Ware	Pounds of Ware	Pounds of Racks	Hours Heating	Hours Enameling	Total Kw.-Hr.	Kw.-Hr. per Hour	Pounds Iron	Racks	Charges
1,306	3,533	6,058	10	..	1,600	.....	560	1,920	139
1,568	3,448	11,625	10	..	1,500	.....	.....	.....	180
1,848	3,160	9,025	10	..	1,400	.....	.....	.....	145
1,252	2,672	5½	22	..	1,000	.....	.....	.....	87
1,169	3,483	6,576	5½	..	2,900	137.8	.....	.....	.....
1,361	3,623	9,350	12½	..	1,600	133	.....	.....	.....
1,584	4,174	9,793	12	..	1,600	133	.....	.....	171
1,951	5,281	9,405	12	9	1,500	125*	.....	.....	18.5
1,716	4,370	10,035	12	9½	1,500	†	.....	.....	17.3
2,124	3,639	11,106	11	9	1,400	127.3	.....	.....	.....
1,674	4,532	11,942	13½	9	1,800	138	.....	.....	.....
1,878	3,314	9,510	11	9	1,400	127.3	.....	.....	.....
2,002	3,593	8,771	10½	9	1,300	128	.....	.....	.....
1,619	3,346	8,634	11	7½	1,400	127	.....	.....	.....
554	594	1,520	9½	9	1,100	136	3,567	3,680	.....
1,641	3,515	7,698	13	7	1,800	138.4	.....	.....	.....
763	2,459	4,722	13	9	1,500	115.3	1,260	900	.....
534	2,388	3,085	10	7	....	.....	....	960	.....

* Oven cut out forty-seven times. † Oven cut out sixty-five times.

COST OF FURNACE HIGHER THAN OLDER TYPES

The total cost of a furnace of this type will vary between $8,000 and $9,000, depending upon the equipment to be installed and the power supply available. The electrical equipment of the oven will cost about $3,500, the electrical installation will come to about $600, the construction of the oven will cost approximately $1,500, and the substation expense will vary between $2,000 and $5,000, depending upon the number of furnaces installed and the share of the substation cost borne by the electrical equipment of the factory. The cost of the electrical furnace is, of course, considerably higher in original investment than with the older type; but the difference in maintenance cost, saving in space and greatly superior product soon make the original investment a matter of minor consideration. At the present time the furnace in the factory of the St. Louis Brass Manufacturing Company is operating only on a night shift, and the hourly energy consumption has approximated 125 kw.-hr. For twenty-four-hours-a-day operation with the continuous hot earth this consumption will probably decrease about 10 per cent. The table gives data regarding the pounds of metal and kilowatt-hours used during recent operation of the furnace.

The general results thus far obtained from the operation of this furnace have been highly satisfactory, particularly with regard to the quality of the enamel produced and the speed with which the oven can be brought to temperature and operated. The electrical furnace can be brought from stone-cold condition to 1,700 deg. Fahr. (927 deg. C.) in twelve hours, which is less than one-half the time that would be required for an oil or gas furnace. The usual operation of this furnace has been to cut it out at 5 o'clock in the morning at a temperature of 1,700 deg. Fahr. (927 deg. C.) and cut it in again at 6 o'clock in the evening at 1,200 deg. Fahr. (649 deg. C.), and in forty minutes the furnace has been ready for charging at 1,600 deg. Fahr. (871 deg. C.). Special studies on production have shown that during an hour the production obtainable is 2,338 lb. (1,059 kg.) of ware and rack with the use of 130 kw.-hr. per hour, the number of charges being twenty-four. This means 900 lb. (408 kg.) of enamel ware with a consumption of 130 kw.-hr. On certain types of work the electric furnace has been able to handle at least 170 heats of No. 22 gage steel in ten hours. The results previously obtained in this factory with an oil furnace have been not more than 130 heats of the same material in the same time.

Similar installations by other enameling concerns are expected, and it is probable that in future installations a double-end furnace may be adopted. There are also possibilities of a conveyor type or a continuous-feed furnace with arrangements for preheating and slow cooling in the application of the enamel. All those who have examined the furnace and have seen it in operation have commented favorably upon its general appearance and the remarkably fine character of enamel product, and it is quite apparent that the opportunities for electric heating in vitreous enameling will be as wide as the field of enameling itself.

Specifications for Skagit River Development

SPECIFICATIONS which have recently been issued by the city of Seattle for the Skagit River development, which is in the Diablo Canyon about 100 miles from Seattle, show that two units will be installed with a rated capacity of 30,000 kva. each. The turbines are to be designed to operate under a maximum static head of 395 ft. (120 m.), of which 380 ft. (116 m.) will be pressure and 15 ft. (4.5 m.) draft head. The main tunnel through which water is conveyed to this plant will be designed to supply three turbines, of which only two are to be installed at present. The net effective head on the turbines, after deducting "draw-down" in reservoir, loss of head in tunnel and penstock, and tail-water elevation above low water, will be 375 ft. (114 m.) when the plant is carrying full load. Until such time, however, as the masonry dam can be completed the plant will operate under a net effective head of 275 ft. (84 m.).

The turbines will be vertical-shaft, single-runner, reaction-type units designed to utilize 1,000 cu.ft. (28.3 cu.m.) of water a second at a net effective head of 375 ft. (114 m.), although the runners to be first supplied will be designed to give maximum power and efficiency when operating under 275 ft. (82 m.) net effective head. The runner to be used under the ultimate head will be designed but not built, as the time during which the plant will operate under the low head is not definitely known. Three hydraulic valves operated by hydraulic pressure from the penstock will be used and arranged for both hand control at the valve and electrically operated remote control.

The electrical equipment will include two high-reactance three-phase, 60-cycle, 11,000-volt, 30,000-kva. alternating-current generators, with direct-connected 250-volt exciters. Each generator and exciter will be operated as a unit, with voltage controlled by a separate automatic voltage regulator.

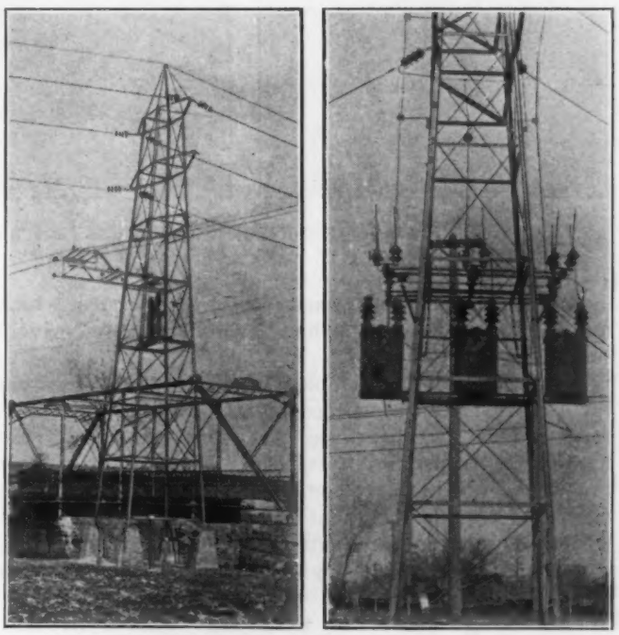
Six 10,000-kva., single-phase, 60-cycle, oil-insulated, water-cooled, outdoor-type transformers are to be operated in two three-phase banks, one for each generator. The low-tension windings will be connected in delta across the 11,000-volt bus, while the high-tension windings are to be connected in Y to give 154,000 volts between lines. The neutral point will be solidly grounded.

The output of this development will be transmitted to Seattle over a 90,000-kva., 154,000-volt, 105-mile (169 km.) transmission line. The specifications call for delivery of equipment to commence during January, 1923, and completion not later than May 1, 1923.

Serving Rural Distribution from High-Tension Lines

Long Distribution Lines Paralleling High-Tension Lines Entail High Copper Expense, While Frequent Taps Are Costly in Transformers

IT IS becoming increasingly difficult to purchase right-of-way for high-tension lines without a clause in the contract binding the company to provide electric service to the property owners. Various farm-lighting



HOW DAYTON POWER & LIGHT COMPANY PROVIDES RURAL SERVICE

Single-phase load center served by 33,000/2,300-volt transformer and (right) three 15-kva., 33,000/2,300-volt transformers for power and light service.

plants have now been in operation long enough to convince the user that the annual operating cost is rarely less than $100, and in many instances more. As a result the rural demand for central-station service is steadily

increasing, and if the rural customer is educated to use $100 worth of central-station service per year, instead of only $25 worth or less, the central stations will find it profitable to extend their lines farther and farther into rural districts. A great amount of skill is required to make rural distribution from high-tension lines as cheap as possible without sacrificing good construction. Low maintenance expense is much more important than low first cost.

There are three methods of distributing to rural customers from high-tension lines—first, by a distribution line paralleling the transmission line its entire length; second, by individual transformations for each customer or group of customers, and, third, by a combination of the first two methods with distribution lines running each way from two or three step-down points.

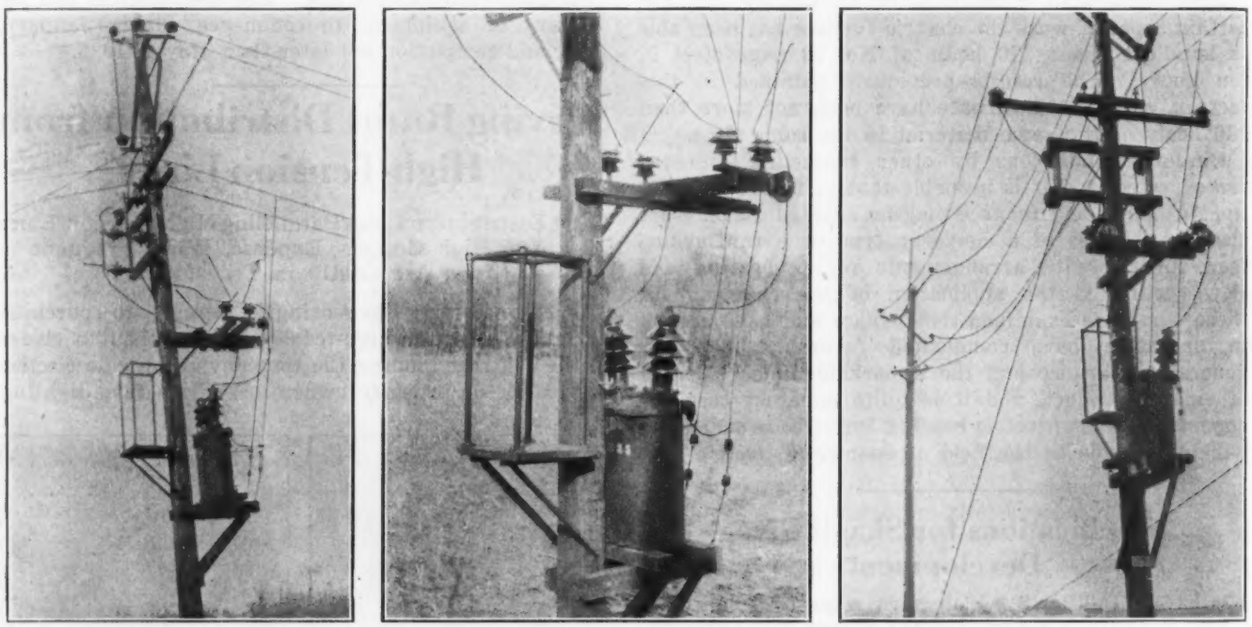
From an operating standpoint and for continuity of service the distribution line paralleling the high-tension line for its entire distance is the best. However, this method is usually the most costly—a feature which makes it prohibitive when customers are widely scattered.

The second method, employing direct transformation for each customer, is not economical in the use of transformers and becomes less and less economical the higher the transmission voltage. Furthermore, every tap weakens a high-tension line and creates a possible source of trouble. Present-day transformers and substation equipment stand up very well under operating conditions, but many high-tension line outages are traceable to some description of substation failures.

Transformer authorities agree that there is virtually no limit to the ratio of transformation which can be safely and satisfactorily used, and the Dayton Power & Light Company steps down 33,000 volts to 230/115 volts in a few isolated cases. It is a rare occasion, however, when the individual rural demands from a high-tension line approach the capacities which would make these individual transformer installations financially economical. For instance, a 25-kva. single-phase transformer with 66,000 volts costs $1,220 or $48 per kva., while a 50-kva. transformer for the same voltage costs only $28 per kva. and a 100-kva. transformer costs only $18.35 per kva. rated capacity.

The third method, which is merely a combination of the two others, is used in the majority of cases because it is the most economical in operation and in first cost. Transformers are used to step down from the high-tension voltage to an intermediate voltage which may be anything up to 14,000, and this intermediate voltage is distributed both ways along the line. The high tension step-down transformers are usually installed near the point of greatest demand.

A modified scheme to save transformer capacity and transformer losses is to step down from the high-tension line to 230/115 volts for a large power job and then step up to 2,300 volts or 6,600 volts for rural distribution along the high-tension lines. The three transformations between the high-tension line and the rural customer's service do not give such good regulation as if only two transformations were used, but this drawback is not serious.



THIS POLE-TOP CONSTRUCTION HAS PROVED SUITABLE FOR STEPPING DOWN FROM 33,000 TO 2,300 VOLTS FOR LOCAL COMMUNITIES

Transformer capacity has also been saved where the rural service is not very dense by the use of 230-volt two-wire secondaries, which can be extended four times as far with the same line loss as if regular 115/230-volt secondaries were used. Most of the customers have been willing to pay the slightly higher price of the 230-volt appliances in order to get the service with the least possible line cost. In some cases dealers would rather give their good customers a 230/115-volt balance coil than to stock the 230-volt appliances. In other cases customers have purchased dry-type balance coils which are all connected to the customer's side of the meter.

In the paper containing the foregoing discussion, which was presented at a recent meeting of the transmission and distribution committee of the Ohio Electric Light Association by R. P. Wuichet of the Dayton Power & Light Company, the author pointed out the impossibility of giving a general solution to cover all cases. He therefore set forth the advantages and disadvantages of the different systems.

Selection of Demand Meters

Study of Characteristic Curves Shows Points that Influence Choice of Meters for Different Loads and Customers—Permanent Records of Demand a Desirable Feature—Suggestions for Improvements in Design

By WILLARD S. WILDER

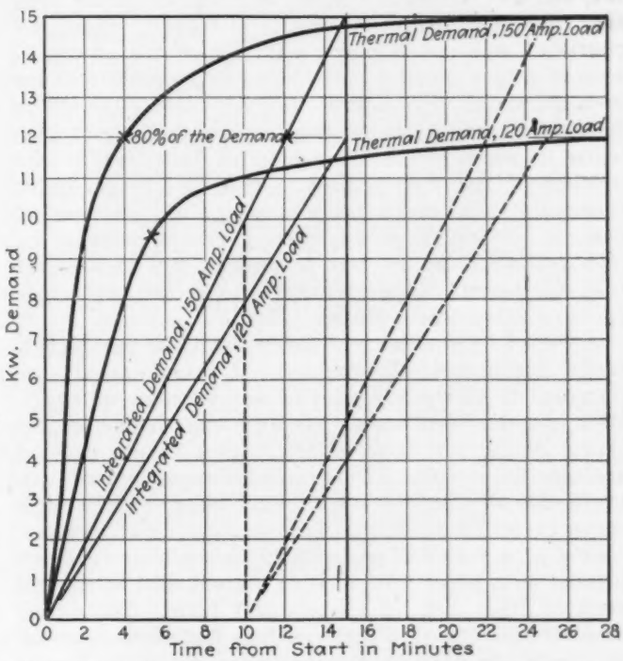
A STUDY of demand meters will show certain relations of type characteristics that influence the selection of equipment. Such points as service rates, type of load, initial cost and maintenance charges have a direct bearing on an intelligent choice of meters. The first consideration, however, is the type of meter as related to the load to be measured and a study of meter characteristics will be found helpful in analyzing such a problem.

Lagged meters and definite time-interval meters are the two general classes into which demand meters may be divided. To the former class belong thermal meters and mechanical demand meters having no fixed timing period, but which start measuring a demand as soon as it occurs. These meters are always lagged so that sudden overloads such as motor-starting currents and high demands for short duration are not recorded. Definite time-period demand meters measure the weighted average energy demand during a fixed period usually of fifteen minutes, thirty minutes or sixty minutes' duration. These meters have no characteristic curve and are simply devices which integrate a load curve over a definite period and record average demand.

Demand meters of the lagged type and of the definite-time-interval type are both subject to error on certain types of loads. The tendency of the lagged demand meters is to read too high and that of the definite-time-interval demand meters is to register too low. A discrepancy will exist on alternating-current loads of low power factor between demands measured by a thermal type of demand meter and demands indicated on an integrating kilowatt-hour demand meter. The demand as recorded by a thermal demand meter will be proportional to the heating effect of the current and is usually considered to be a sound basis for a demand charge. The demand as recorded by an integrating kilowatt-hour demand meter, on the other hand, will be based on the actual demand for power. The thermal demand meter which depends upon the heating effect of the electric current for its operation registers proportional to current values only, hence does not record the power demands on alternating-current loads operating at other than unity power factor. Consideration must be given to these differences in choosing a demand meter for any class of service as the reading must correspond with the definition of demand in the power contract.

It will be noted from the curves that it takes the thermal demand meter twenty-five minutes at a constant load of 15 kw. to record the actual demand, the time lag being thirty minutes at 12 kw. While it took four minutes for the demand meter to register 80 per cent of the demand when the load was 15 kw., it took nearly five and one-half minutes for the same meter to reach 80 per cent of the demand when the load was 12 kw. This lagging of the characteristic curves on decreased loads is common to thermal demand meters and decreases their effectiveness in registering light demands of short duration.

The definite-time-period demand-meter curve is effectively a straight line as shown in the figure. Demand meters of this type simply count the revolutions of the watt-hour-meter disk, and at the end of fifteen minutes, which is the usual time interval, the pointer returns to zero and again starts counting the demand. Hence for


Thermal Demand, 150 Amp. Load
80% of the Demand
Thermal Demand, 120 Amp. Load
Integrated Demand, 150 Amp. Load
Integrated Demand, 120 Amp. Load
Kw. Demand
Time from Start in Minutes
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28

CONSIDERATION OF DEMAND-METER CHARACTERISTIC CURVES WILL ENABLE AN INTELLIGENT SELECTION BASED ON REQUIREMENTS

the loads under consideration the definite-time-interval meter will register the true demand at the end of fifteen minutes, after which the pointer will be returned to zero and the meter will again start registering the demand. It will be noted that with this type of meter 80 per cent of the load is registered in twelve minutes, or 80 per cent of the fifteen-minute period, regardless of magnitude of load, owing to straight-line characteristic.

Comparison of the two characteristic curves for these demand meters shows that for constant loads of fifteen minutes or slightly longer duration the thermal demand meter will not record the true maximum, while the definite-time-period meter will record the true maximum demand. On the other hand, the thermal demand meter begins registering as soon as the load is applied, while the other demand meter may not. Thus if the load was about twenty minutes' duration the thermal demand meter would record nearly the correct demand, and if the load was applied five minutes after the time period

started on the definite-time-period meter, this meter would record but 66.6 per cent of the true demand during the remainder of the period. The time interval being up ten minutes after the load was applied, the pointer would return to zero and would again start counting the demand as shown in dotted line in the figure.

Should the total duration of the load be but twenty minutes, the definite-time-period demand meter would indicate two demands of only 66.66 per cent of the actual demand.

PERMANENT RECORDS OF DEMAND DESIRABLE

In addition to recording the time a maximum demand occurs, a permanent record of its value is also desirable. Several demand meters furnish permanent records on paper charts, but nearly all have disadvantages that practical central-station metermen would like to see removed. Demand meters employing an inking pen are unsatisfactory because of blotting and running of the ink, and unless frequent attention in given to the pens they will not operate properly. Specially surfaced charts of wax-coated paper upon which the record is scratched by a metal pen fail to operate properly under wide ranges of temperature. In cold weather the stylus fails to make a legible impression through the cold wax, while in warm places the record is destroyed by the melting of the wax surface. A small electric light, thermostatically controlled and placed in the case of demand meters using wax-surface charts, lessens the cold-weather difficulty, but no remedy has been found that will permit the waxed charts to be used near furnaces or other warm places.

A record from a demand meter should be permanent, easily interpreted, and the demand values quickly determined from the record with a minimum of effort. Both graphic watt-meter records and demand-meter charts giving the value of any fifteen-minute demand are easy to interpret, but the demand-meter records are preferable as they do not require the averaging of a curve to determine the demand value. Records which consist of a series of periodical kilowatt-hour readings printed on a paper tape require a great deal of clerical work to place them in a convenient form. The difference between kilowatt-hour readings for consecutive demand periods must be obtained over the entire record and placed upon a sheet opposite the time of the demand before the maximum demand and time of its occurrence can be ascertained. A general inspection of the record tape will not suffice in determining the maximum demand, since the opportunity for error is too great, especially where the billing maximum demand is based on the two or more highest recorded demands. Demand records in the form of lines drawn every fifteen minutes on a paper chart prove more satisfactory when drawn on paper tape than when drawn on a circular chart. Demand records drawn on a circular chart are difficult to interpret for low values of demand, and when it becomes necessary to obtain a customer's demand during an hour of off-peak service it becomes nearly impossible to read the chart because of the wedging of these short lines between lines of much greater magnitude with a consequent loss of legibility.

The application of a demand meter to any service must not in any way interfere with the reliability of that service or with the accuracy of the metering of the energy consumption. Demand meters directly connected in the service leads introduce one more set of connections at the service entrance which may prove a weak link in the circuit. Demand meters dependent upon the watt-hour meter for operation are connected electrically or mechanically to the registering mechanism of the watt-hour meter and unless carefully installed may increase the friction of the mechanism. Difficulty is experienced in calibrating a watt-hour meter equipped with a cam and set of contacts for closing an electric circuit through the demand meter. The varying friction of the contact fingers over different steps of the cam causes a variation in drag on the watt-hour meter disk so that accurate test results cannot be obtained unless a long test interval is employed. A similar difficulty in adjusting a watt-hour meter is experienced with demand indicators directly connected to the meter shaft.

Aside from the points mentioned, the greatest difficulty—and unfortunately a very serious difficulty—is found in the demand-meter contacts. These contacts, which are mounted in the watt-hour meter, count the revolutions of the meter disk, closing a circuit through the demand meter which causes the pointer to rise. The friction of the contact arms passing over the cam teeth produce an uneven lag upon the watt-hour meter disk which makes calibration difficult and temporary. By far the most serious trouble with the contacts is caused by their chattering or vibrating, which causes the demand meter to operate when it should not. Cases have come to attention where the maximum demand of a customer as indicated by the demand meter occurred at time of very light load when the plant was nearly shut down. In these cases the watt-meter disk was moving slowly, bringing the demand meter contacts into close proximity for a short period of time, during which vibrations caused a chattering of the contacts, rapidly opening and closing the circuit and recording a high demand. The design of a suitable contactor is sorely needed for demand meters which depend upon the revolutions of the watt-hour meter, since this type of demand meter has many advantages. It is easily adapted to any circuit, is simple, reliable and requires no separate calibration from the watt-hour meter.

FIRST COST OF METER AS WELL AS OPERATING EXPENSE IMPORTANT

While reliable metering of the demand and energy requirements of a customer are very important considerations, the initial cost and operating expenses of such equipment are also factors of great importance. In order to reduce the purchase price and installation costs of metering equipment it is desirable to combine the watt-hour meter and the demand meter into one instrument inclosed in one case, but the present tendency in design appears to favor a demand meter separate from the watt-hour meter but connected electrically to it. Demand meters of the lagged type and other meters which do not furnish a record of the time a demand occurs require less attention than those using a chart or paper which must be changed or inspected about once a week.

There is a great need for a simple and reliable demand meter which will furnish a record of the demand and the time it occurs and at the same time will require attention only once a month. Such a meter would give all the values required and would need attention only when it was read. With a few exceptions all the clock mechanism and paper records at present employed in demand meters require attention at least once a week, and where

a large number of such demand meters are in use the continual services of one or more men are necessary.

Demand meters which simply count the revolutions of the watt-hour meter disk require no calibrating, while those of the thermal type and self-contained demand meters must be kept in calibration. This increases their operating costs.

Adaptability to a large variety of conditions is desirable in demand meters in order to reduce the number of types of meters that must be kept on hand. As thermal demand meters record a demand which is proportional to the root mean square or heating value of the current, they can be used on direct-current and alternating-current circuits of any frequency. With alternating-current circuits of high voltage or large current values these demand meters may be used with current transformers. Demand meters dependent upon the watt-hour meter for operation are limited in adaptability only by the source of energy available for operating the recording mechanism. The same source of potential that supplies the watt-hour meter is generally used, although where this may be unsatisfactory for the demand meter it is not uncommon practice to operate that meter from some other source.

Another requirement for a good demand meter is to have a large recording range with convenient increments so that unusually high demands may not be lost because they are beyond the maximum range of record. Meters which continually record the revolutions of a watt-hour-meter disk and indicate the demand by the difference between consecutive energy readings can be adapted to record small increments of power and are not subject to the objection of having a limited demand range, as is the case with most other demand meters.

Some of the lines have been indicated along which improvements are needed in the design of demand meters. Cheaper meters are wanted also, to permit more extended use of these contrivances so that demand charges will no longer be based on estimates of connected load.

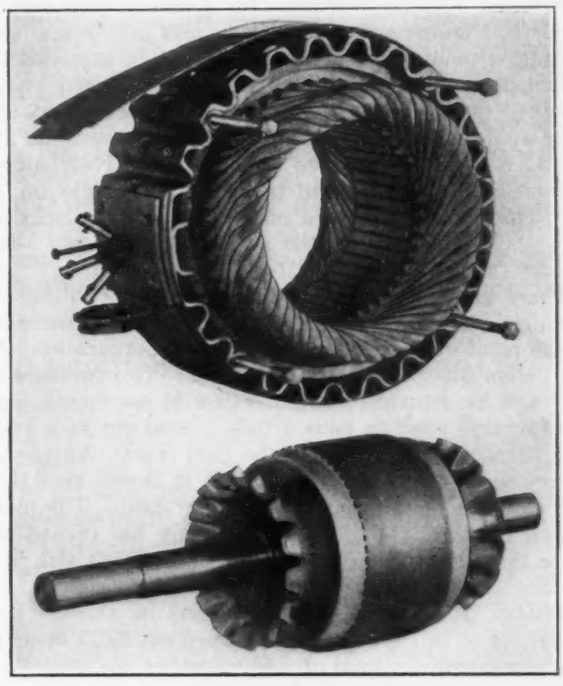
Unique Ventilation Scheme for Polyphase Motors

Designed to Prevent Dirt Accumulation and Oil from Coming in Contact with Windings—Rotor Cage Is Cast in One Piece

TO PREVENT the accumulation of oil on motor windings and the resulting collection of dirt a line of polyphase induction motors has been brought out recently in which an unusual method of ventilation is used. The scheme is to screen the ventilating air before it enters the windings and so to direct this air that it opposes the entrance of oil into the windings from the waste-packed bearings. The waste-packed oiling method has been adopted also to overcome any tendency toward spilling of oil when vibration is particularly severe.

While the motors are ventilated or air-cooled, they are virtually inclosed from a mechanical standpoint. Air enters at the periphery of the machine and is discharged at each end, the direction of air flow being exactly opposite to that found in most motors. It is claimed that oil leakage caused by careless filling cannot occasion bad results, because such oil is expelled from the ends of the motor instead of being driven into it. Hence there should be little opportunity for an accumulation of dirt and lint on the windings that might be caused by the stickiness of an oil film.

These motors are provided with a novel frame or casing consisting of a series of corrugations formed from a single piece of sheet steel. These corrugations are equidistantly spaced and in intimate mechanical contact with the stator core, so that considerable of the heat generated in this core and its winding is conducted to this casing, which therefore forms an efficient means for transferring heat to the ventilating air by radiation. Air entering at any point along the surface of the screen travels over the outside of the corrugation through holes provided at the center of these corrugations, then through the lateral ducts between casing and core, then over the windings at the end, and finally is discharged at each end of the motor. This corrugated



POLYPHASE INDUCTION MOTOR DESIGNED TO PREVENT OIL ENTERING WINDINGS AND PARTS SHOWING INTERESTING VENTILATION SCHEME

casing, therefore, contributes to the efficiency of the ventilating system to a marked degree and at the same time forms an exceedingly rigid and accurate frame for the stator core.

Fans are provided at the ends of the rotor for the purpose of drawing the cooling air through the machines. They are said to be of unique design and construction in that a stream of air is drawn directly over the bearing housings and immediately expelled without entering the motor, while another stream is drawn through the machine and expelled at the same points. These fans are made of a single piece of sheet steel and welded to the thrust collars.

These motors employ rotor windings having bars and end rings made of one piece of metal, entirely eliminating mechanical or electrical joints, the windings being molded or cast on the magnetic core.

These motors are now built in sizes up to 30 hp. at 1,800 r.p.m. for 60-cycle polyphase circuits, with corresponding capacities at other standard speeds and frequencies.

Readers' Views and Comments

This is a readers' forum. Comments on questions before the electrical industry presenting economic, financial, engineering or commercial aspects and new or supplementary viewpoints on published articles are cordially invited

Further Data on Snyder Furnace Operation

To the Editor of the ELECTRICAL WORLD:

SIR: In the March 12 issue of the ELECTRICAL WORLD, page 605, an article appeared entitled "Operating Records of Electric Furnaces for Refining High-Grade Steels." Figures such as given in this article are misleading without some investigation of the surrounding circumstances. If the figures as published were accepted by any prospective user of electric furnaces, they would work against the electric furnace industry, and if it were not for the fact that we have changed our designs for furnaces of that size, they might injure us. The figures cited are not typical ones in making castings, which is what the article says the two 1-ton Snyder furnaces were used for.

There are a number of furnaces in use in different foundries of the exact size of the two Snyder furnaces at the plant of the United Alloys Steel Corporation. At the Pelton Steel Company in Milwaukee two furnaces of that size have turned out more steel in one month than the furnaces cited in your article turned out in a year. The furnaces referred to in the ELECTRICAL WORLD are described as 1-ton furnaces, and it is shown that they turned out something over 2 tons per heat. The plant of the Dayton Steel Foundry Company has turned out more than 250 tons from one furnace of that size in a month. In an article published in the *Foundry* for February, 1918, by C. E. Messenger, he showed that a furnace of this type and size turned out 2,029 heats in thirteen months, a total of 2,560 tons, or approximately 2,300 tons in one year.

In the article in the ELECTRICAL WORLD an electrical consumption of 1,002 kw.-hr. per ton is given. The results of the operation cited above for the Pelton Steel Company, when operating day shift only, were approximately 600 kw.-hr. per ton; results for the Dayton Steel Foundry were 524 kw.-hr. per ton, and the figures given by Mr. Messenger in the article referred to were 570 kw.-hr. per ton. In your article an electrode consumption is given which would mean a cost of approximately $4 per ton for electrodes, whereas single electrode furnaces of that type are operating for $1 and under per ton for electrodes. The figures given by Mr. Messenger showed 70 cents per ton of metal melted, but, of course, that was when electrodes were somewhat cheaper than at the present time. Allowing for the difference in market price at the date of his article and today, the price would be around $1. The author of your article shows the charging time as thirty minutes.

The Western Crucible Steel Casting Company has an exact duplicate of the furnaces at the United Alloys Steel Corporation's plant and gave us a letter showing that this furnace had been charged 2,520 times with a drop-bottom charging bucket, that it never took more than two minutes to charge and that all charging was done by one man.

F. VON SCHLEGELL,
President.
Industrial Electric Furnace Company,
Chicago, Ill.

The American-Swedish Electrical Commission in Switzerland

To the Editor of the ELECTRICAL WORLD:

SIR: As already stated in a former issue of the ELECTRICAL WORLD, an American-Swedish commission of electrical engineers recently inspected the Swiss electric railroads. The commission has now finished its work and has just left the country. In addition to the Director-General of the Swedish State Railways, F. H. Sheppard, director of heavy traction Westinghouse Electric & Manufacturing Company, and J. V. Dobson and F. E. Wynne, electrical engineers of the same company, took part in the inspection and consultations which followed the trip. The commission visited the Lötschberg line from Spiez to Brigue and the St. Gotthard line. A close study was made of the electric installations and power stations on both lines. Special attention was paid to the capacity and wear and tear of the heavy electric locomotives with a view to the cost of maintenance.

It was stated that the chief reason for these investigations is the difference of opinion existing among electrical engineers in regard to whether the single-phase alternating-current system or the direct-current system should be used in the construction of electric railway lines. The United States and France are in favor of direct current, while Switzerland, Germany and Sweden prefer the single-phase system, the latter having been proved to work very satisfactorily on the Swiss lines. In addition, it was stated that the cost of the direct-current system and of its maintenance was much greater than that for single-phase.

Sweden possesses an electric railway about 100 km. (62 miles) in length in the extreme north of the country, connecting the mining district of Kiruna with the Norwegian port of Lulen, the shipping port for Swedish iron ore. Four passenger trains and numerous freight trains are daily running over this line. It is now intended to extend it eastward to a port on the Bottnian Bay. At the same time the Stockholm-Gothenburg Railway, one of the most important lines in the country, is to be electrified, and it seems that the Swedish engineers who took part in the Swiss inspection trip will advocate for this line the single-phase system in use on the Swiss electric roads. The Swiss railway and electrical engineers who accompanied the foreign delegates said that the single-phase system is giving very satisfactory results. In Norway the Christiania-Bergen Railway is also about to be electrified.

HENRY L. GEISSEL.
Münsingen-Berne, Switzerland.

Asserts that Choke Coil Was Patented

To the Editor of the ELECTRICAL WORLD:

SIR: The strain-type choke coil described in an article published in your paper appearing Jan. 29, on page 261, is covered by patent (No. 769,057) granted me in 1904. Such a coil is now made under royalty contract by the General Electric Company, the Westinghouse Electric & Manufacturing Company and the Delta-Star Electric Company.

GEORGE S. CARSON,
President.
Iowa Gas & Electric Company,
Washington, Iowa.

Station and Operating Practice

A Department Devoted to Problems of Installation, Operation and Maintenance of Equipment for Economical Generation and Distribution of Electrical Energy

Choosing Economical Size of Generator for Power Plant

IN DECIDING on the size of generators for a plant the most important factor to consider is the load conditions. As an example to show application of principles, let it be assumed that a plant is to be designed to furnish an industrial load of about 15,000 kw. average and with peaks running up to 25,000 kw. In selecting the generators the first principle to be remembered is that generally the larger the unit is the more economical it proves. To begin with, assume that two units are to carry the maximum load running up to 25,000 kw. In this case the rating of the units would be 12,500 kw. each, which happens to be a commercial size. As the average load is 15,000 kw., each will carry 7,500 kw., or about 60 per cent of the maximum load. From a steam-consumption point of view the most economical load is about 70 to 75 per cent of the maximum load. Thus it is seen that the two units would not be working quite on their most economical point as the nature of the load will not allow this. If the plant is not tied in electrically with any other plant and the load must be carried, then a spare unit should be installed, in which case the plant would be composed of three turbo-generators of 12,500 kw. each, or 37,500 kw. in all.

Now suppose the load to be carried by one unit. It must have a capacity of 25,000 kw., and a spare unit would require the installation of 50,000 kw. On the other hand, suppose the load to be carried by three units. Then each would be loaded to 8,300 kw., while the nearest commercial size is 7,500 kw. If the swings up to 25,000 kw. were of short duration and the steam pressure were high, perhaps the best thing to do would be to have the turbines designed for 200-lb. steam pressure at the throttle. Then if the steam pressure were raised to 225 lb., a 7,500-kw. unit would carry 8,300 kw., as the load carried is directly proportional to the absolute pressure of the steam. At the normal load each unit would carry 5,000 kw., which is 66 per cent of the maximum load and therefore somewhat nearer the most economical point for the unit. With one spare unit, this means four 7,500-kw. machines, or 30,000 kw. in all.

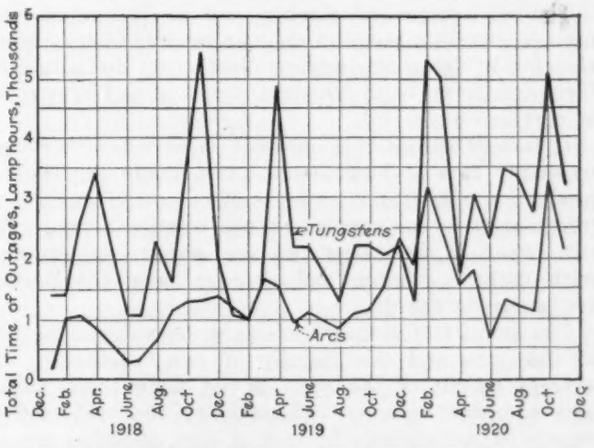
There is, therefore, a choice between two 25,000-kw. units with an aggregate rating of 50,000 kw., three 12,500-kw. units totaling 37,500 kw. and four 7,500-kw. units giving an installed capacity of 30,000 kw. Now, the cost per kilowatt is rather less the larger the unit, and this applies to the floor space covered, piping, auxiliaries, etc. Moreover, in nearly all plants the demand for power will increase, and consequently larger units will be used in extensions made later. From all points of view the three 12,500-kw. units appear to be the best for the conditions. Two will run on the load, the question of a spare depending upon whether the plant is tied in electrically with any other plant that can supply the demand if one unit breaks down.

In a plant of this kind the steam pressure and superheat should be as high as standard piping, valves and fittings will allow, which is about 250 lb. pressure and 250 deg. superheat. With these standards 250 lb. will be the maximum pressure in the boiler drum when all safety valves are blowing and relieving the boiler of the maximum weight of steam. Allowances must be made for pressure drops through piping, valves, etc., bringing down the steam pressure at the turbine throttle to about 200 lb. and the superheat to about 200 deg. Fahr. The distribution of steam pressure will be about as follows. Normal working pressure in boiler drum, 230-lb. gage; pressure after passing superheater at boiler outlet, 220-lb. gage; pressure at turbine header, 210-lb. gage. Thus, if the turbine is designed for 200 lb. pressure, there is a little leeway and it will carry easily its maximum load.

A. B. CLARK,
Sargent & Lundy, Engineer.
Chicago, Ill.

Condition of Lighting Circuits Checked by Graphic Record

ANY unusual conditions in the street-lighting circuits of the Worcester (Mass.) Electric Light Company are indicated by irregularities in the curves which are made up monthly showing the outages of both arc and incandescent street lamps. These curves show the number of lamp-hours during which the lamps were dark



OUTAGES OF STREET LAMPS PLOTTED GRAPHICALLY TO AID IN PREVENTING TROUBLE

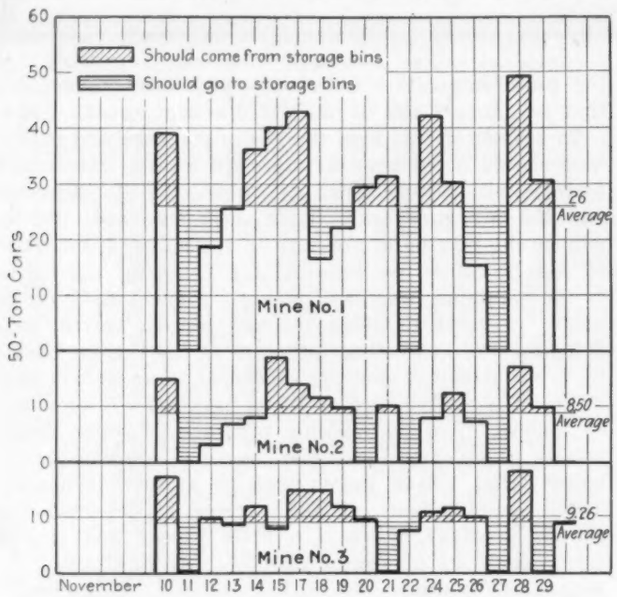
when they were supposed to be lighted. They are plotted from the monthly record from the city bills to the company for the outages.

Such graphic records are useful for many other purposes. George M. Hardy, superintendent of the company, planned and developed these records.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Storage at the Mines to Prevent Coal Shortage

THAT the storage of coal at the mines would stabilize the output, make production more uniform and provide more continous employment at the mines was brought out by John W. Lieb, vice-president


Should come from storage bins
Should go to storage bins
50-Ton Cars
Mine No. 1
26 Average
Mine No. 2
8.50 Average
Mine No. 3
9.26 Average
November 10 11 12 13 14 15 17 18 19 20 21 22 24 25 26 27 28 29

HOW PRODUCTION AT THREE WEST VIRGINIA MINES MIGHT HAVE BEEN STABILIZED

The hatched areas above the average lines indicate the amount of coal that should be stored. These loadings occurred in a non-union district during the 1919 strike. Hence the car supply was at a maximum as cars that would normally go to a union district were diverted to this district.

These curves thus show the advantage that mine storage would have when the car supply is at its best. Under average conditions this advantage would, of course, be much greater.

of the New York Edison Company, in a recent paper read before the American Society of Mechanical Engineers.

The advantages of storing coal at the mines are brought out in a striking manner by Mr. Lieb's curves showing in the accompanying illustration the output of three mines in West Virginia for a period consisting of eighteen days.

It is well known that in most cases when there are no empty cars at bituminous mines ready for loading production stops and labor is idle for the day. The irregularity in car supply and the relation between the car rating of the mine and the empty car placings, with daily maximum and average over the period, are shown in the diagram.

The amount of storage necessary depends on the size of the mine and the scarcity of cars. Roughly, the average output of the mine is not more than 60 per cent of rated capacity. Considering that this difference is caused entirely by lack of cars, it would appear from a study of the diagram that, as the car shortages are daily rather than weekly or monthly, in a 1,000-ton mine a bin storage capacity of forty cars, or approximately 2,000 tons, would be ample to take car of ordinary irregularities in car placing.

There should be a distinction between shaft mines and slope mines. In slope mines the haulage and storage problems are easy and cheap, for the cars instead of going to the tipple are switched off over the storage pocket and dumped. In shaft mines with self-dumping cages a belt conveyor below the screens will serve the same purpose.

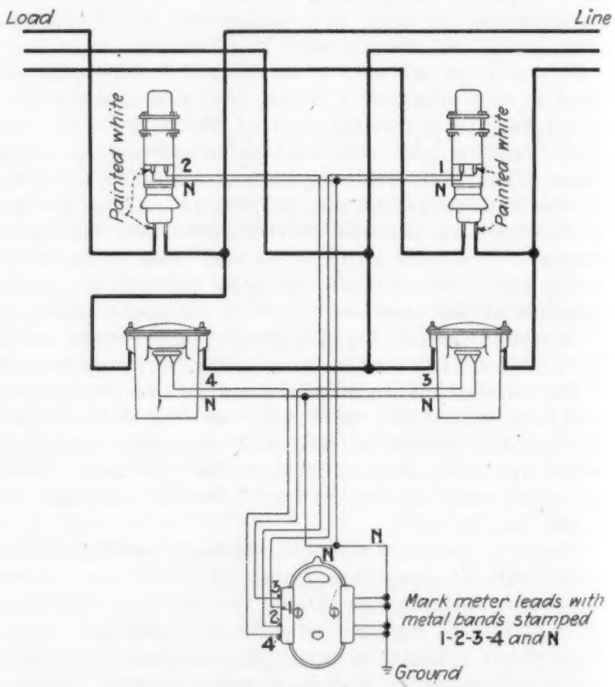
Taking the mean cost as between wooden and concrete construction, the 2,000-ton pocket and machinery would cost about $30,000, or $15 per ton, the fixed charges being 20 per cent, or $3 per year. At forty fillings this would be 7.5 cents per ton, which would be quite lost when weighed against the added output of 80,000 tons per year and the more constant employment of labor with its enhanced efficiency.

Standard Equipment Used for Outdoor Metering Sets

BY THE use of standard distribution transformers as potential transformers and other stock material in the make-up of 11,000-volt outdoor metering sets the Pacific Gas & Electric Company has made a saving of about $125 per set. The use of ordinary lighting transformers for this purpose might be questioned, but the results of tests have shown its feasibility.

These metering sets were developed primarily for the purpose of metering reclamation pumping plants where the company's rate schedule called for metering on the primary side of the transformers. Several designs of outdoor sets have been made and used by this company. A self-contained set was tried which had current and potential transformers installed in an oil-filled metal case, the meter being in a box at the base of the pole. These have all developed weaknesses such as inaccessibility and hazards, besides being too expensive.

The cost of the present set installed, excluding the pole, is $410, which compares very favorably with the

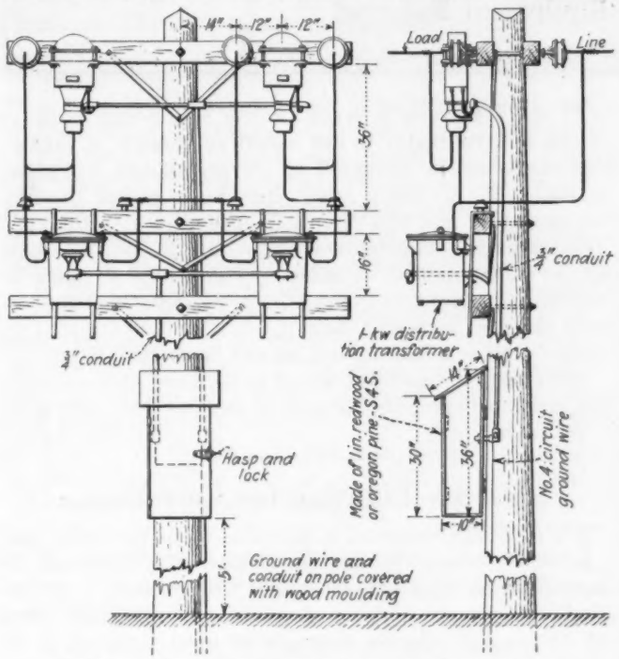


CONNECTIONS ARE INDICATED BY METAL TAGS

cost of other installations and is about $125 less expensive than the self-contained sets referred to. Attention is called to the fact that neither switch, fuse nor protective device is shown, as use is made of the main-plant switch and fuse for protection. These are installed

one pole back from the meter pole. It has for the following two reasons been found poor practice to fuse such meter installations:

It is virtually impossible to make a suitable fuse that will protect such small transformers, and if a fuse on a potential transformer did blow, it might be



THIS METERING SET USES STANDARD DISTRIBUTION TRANSFORMERS

some time before the accident was detected and more loss in revenue might be caused than the total cost of the transformer.

C. E. YOUNG.

Pacific Gas & Electric Company,
San Francisco, Cal.

Ground Wire Should Have Low Resistance and Reactance

IN GROUNDING a transformer secondary three requirements are most important: (1) The ground wire must be permanently and strongly connected. (2) A ground wire of very low resistance is important in order to protect the house circuits from high voltage due to crosses with the primary circuits, the possibility of a lightning surge, or the result of a breakdown between the primary and the secondary winding of a transformer. (3) The wire should be installed to reduce the reactance of the circuit to a minimum, thereby protecting the house circuits and transformers from lightning disturbances.

Wherever it is possible to attach a ground wire to a water system this should be done to insure both a permanent and a low-resistance ground. As this is not always convenient, the next solution is to drive an 8-ft. or 10-ft. length of ¾-in. galvanized-iron pipe into the ground at the base of the pole. It is generally considered that a ground connection of 20 ohms resistance or less is satisfactory, and therefore it is recommended that either a No. 6 or No. 4 B. & S. gage copper wire be used for the ground. Copper should be employed in preference to galvanized iron on account of its lower resistance and the possibility of the latter corroding at the ground line.

Experience has proved that a lightning arrester for the protection of the transformer should be on the same pole with the transformer, but it is undesirable to connect the lightning-arrester ground to the same ground wire as that of the secondary neutral. Therefore it is suggested that the secondary neutral ground wire be installed on the pole adjacent to the transformer and be properly protected from accidental contact by means of wood molding.

THEODORE H. RICE,
Operating Department.

Henry L. Doherty & Company,
New York, N. Y.

Diesel Engines Chosen for 2,500-Kva. Standby Plant

FOUR 750-hp. Diesel engines each direct connected to a 625-kva. generator are to be installed in the 2,500-kva. Calumet generating station of the Sanitary District of Chicago. The primary purpose of the Calumet power plant will be to supply standby energy to the electrically operated Calumet and Ninety-fifth Street sewage-pumping stations. In addition the plant will feed its energy into the general power distribution system of the Sanitary District, supplementing the hydro-electric plant at Lockport, Ill., during its peak load.

The amount of electrical energy required for the ordinary or dry-weather flow through these pumping stations is approximately 500 kw. and for the maximum or flood flow approximately 2,000 kw. The energy required will vary according to the number and severity of rainstorms.

The Lockport power plant supplies energy to various industrial and municipal works and to the street-lighting systems of the city of Chicago and vicinity. If all the energy for the pumping stations were supplied from this power plant it would mean that the maximum energy required for the pumping stations must be held in reserve at all times. It was therefore found to be more advantageous to provide a standby service than to hold in reserve this maximum energy. This standby power plant can in turn supply its energy to the general power-distribution system of the Lockport plant during its peak load, when the street-lighting load comes on before the large power users are off the line. This occurs during the winter months.

After exhaustive studies of various types of prime movers, the conclusion reached was that this standby service should be procured from a plant consisting of Diesel engines directly connected to generators. This conclusion was due to the many advantages of this type of prime mover for the sizes required. They have a very high thermal efficiency and are self-contained, there being no boiler plant with its smoke and soot. If of good make they are reliable and can give full power quickly. Moreover, the fuel saving as compared with a steam plant is considerable and for a standby plant is very marked.

Although the initial cost of a Diesel plant figures approximately 10 per cent higher than that of a condensing-type steam-turbine plant of the same size, the estimated annual charge against the Diesel plant is about one-third of what it would be against the steam-turbine plant. This difference in the annual charge over a period of three years will more than offset the initial cost.

H. I. STEFFA,
Mechanical Engineer.

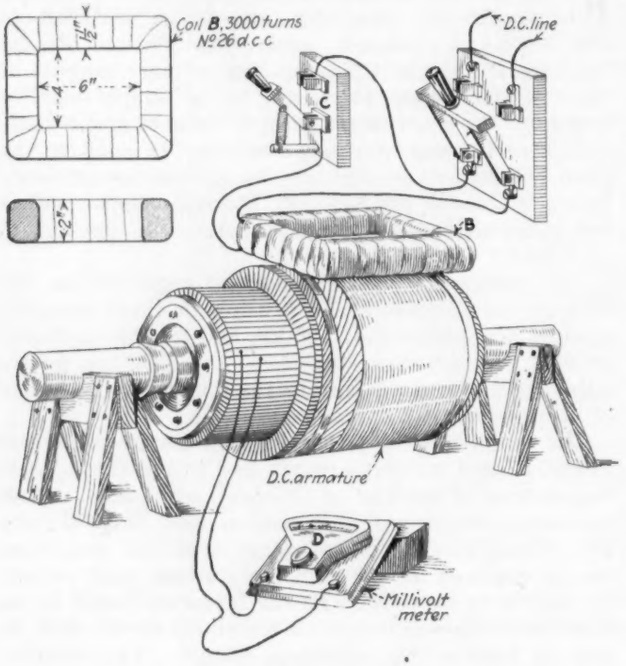
Sanitary District of Chicago,
Chicago, Ill.

Industrial Applications

The Economical Utilization of Electrical Energy in Mills and Factories, Together with Practical Details of Installation, Control, Testing and Repair of Equipment Required

Kick Method of Locating Reversed Coils

FOR locating reversed coils in an armature the "kick" method has proved very successful in a New Jersey repair shop. This method is illustrated in the accompanying sketch, showing the plan of a direct-current



A REVERSED KICK ON OPENING SWITCH *C* SHOWS A REVERSED COIL

armature which has been rewound and which it is desired to test for reversed coils. A direct-current field coil *B* is laid alongside this armature, and a direct current is passed through this coil. Current in this coil is controlled by the switch *C*. A millivoltmeter *D*, or other low-scale, permanent-magnet type voltmeter (not too dead-beat), is connected across two bars of the commutator.

When the switch *C* is opened sharply there will of course be a kick in the meter. Experience has shown that the kick when the switch is opened is greater than when it is closed, and the kick on opening is the one which should be used. Choose two bars so located that the kick is the maximum and always keep the coil under investigation in this position by rotating the armature on horses as each coil in the armature is explored. The kick should be substantially the same in value and in the same direction for every coil, provided that the armature is wound with coils all having the same number of turns. A reversed coil will show a kick in the reverse direction. If the number of turns in the armature varies, the kick will be greater for the larger number of turns in a coil. Their location in the armature can therefore also be checked.

If the armature is large or has single-turn coils or if the millivoltmeter is not sensitive enough, a greater deflection can be obtained by reversing the foregoing method. To do this a heavy current is passed through the armature and this circuit is opened to give the kick. The meter is connected across the coil B, which is held in the same position as before. This coil B is made by winding about 3,000 turns of No. 26 double-cotton-covered magnet wire on a 4-in. x 6-in. form 1½ in. to 2 in. wide. The coil may be left on the form if desired.

This method has been found to be more accurate than the standard compass method of locating reversed coils.

Newark, N. J. F. W. GAY.

Effective Lighting for Core Room

THE CORE room of a foundry, with its high shelf racks, ovens, mixing machines, etc., presents no easy lighting problem, especially where detail is so important as in the making of small and odd-shaped cores of dark sand. As an example of good lighting, a recently equipped new core room in a New Britain (Conn.) foundry may serve as a timely subject. The room has a concrete floor measuring 70 ft. x 60 ft. It has a well-ventilated roof monitor, the main ceiling being 18 ft. high, with I-beams, truss bars and chords 20 ft. apart. Thirty-two core makers' benches, arranged four in a row, are placed on the east side of the room alongside windows. Over each section of eight benches are placed two 100-watt nitrogen lamps with 15-in. steel-dome reflectors, making eight lamps in all, 10 ft. apart. There are two circuits each feeding four lamps and lighting sixteen benches. These lamps are 10 ft. above the floor, and give about 4 ft.-candles at the work on the benches.

The large cores are made along the south wall, and light is supplied by three 100-watt lamps suspended from a taut iron messenger wire, the light line running from beam to beam, supported by knobs attached to wooden blocks held up by thin steel hooks. These lamps are also 10 ft. above the floor. They have steel reflectors and are wired with pendant switches, so that any one may be shut off as desired. The wire machine is in the southwest corner and is run by a three-phase, 440-volt induction motor suspended from an overhead beam. Here a 25-watt tungsten lamp, with a wire guard for protection, affords the light. The core pilers are along the middle of the room and receive light from five 100-watt nitrogen lamps with 15-in. reflectors, suspended 12 ft. high, and controlled from the switch box. The core racks are along the north wall, arranged in a lower and an upper section, both 35 ft. long. Each section is lighted by three 25-watt lamps having key sockets. These are hung from a cord which slides along a taut iron wire, allowing them to be shifted across the face of the racks. The coal-heated oven is near the center of the room and has two 25-watt lamps on each of two sides and one over the fire pit, the last-named also lighting the thermometer of a gas oven near by. The

oven lights are controlled by a snap switch on the oven wall, and also at the switchbox. The employees' lockers and washbowls are at the north end, and light is provided by one 40-watt lamp, with wire guard, 8 ft. above the floor and in the center of the small room. A night line runs through the room from the engine room and supplies two 25-watt tungstens in opposite corners. The foreman's office has one 40-watt lamp with a china shade.

In all cases where lamps fall between the I-beams they are suspended from a taut iron wire, and where they hang under the beams 8-in. boards and knobs support the lines. The switch box, installed in the foreman's office, is of steel, with a six-circuit slate panel with push-button switches and inclosed fuses.

All circuits are controlled from the foreman's office. Conduit ½ in. in size carries the branch circuits up the wall to the ceiling, where the lines are then run open on knobs. The main, of No. 6 wire, is brought from outside, through a 12-in. brick wall, and down to the panel box in 1-in. conduit. The whole room, walls and ceiling, are coated with white cold-water paint applied with a pressure tank. The result is a remarkably well-lighted room, especially over the core makers' benches. The electrical lighting load is only 2,000 watts. The effect is easily 100 per cent better than it was in the old core room, which was torn down. The wiring took two shop electricians one week to complete, allowing time for other jobs about the plant.

H. S. RICH.

East Berlin, Conn.

Combined Conduit and Wiring Tables Aid Wiremen

IN DETERMINING the proper size of wire and conduit to use wiremen of the Southwestern Shipbuilding Company are assisted by the two tables shown herewith, which are printed on one sheet. Blueprints are made of this sheet and a copy is given to each electrician. Table I shows the approximate current per terminal for induction motors of one, two and three phases, 110, 220 and 440 volts, and from 0.5 hp. to 250 hp. After the proper current is determined Table II is consulted and the size of wire necessary to carry this current is found in the second column. When the size of wire is known, then the size of conduit necessary is determined from the body of the table. As an example, suppose the motor is a 30-hp., three-phase, 220-volt motor. In Table I, opposite to the 30-hp. notation and underneath the 220-volt, three-phase column, the amperage per terminal equals 81. Consulting Table II it is seen that for 81 amp. a No. 2 wire must be taken, as this wire is the smallest which will carry this current. Looking in the body of the table it is found that for three No. 2 wires a 1½-in. conduit is necessary. From Table I the size of fuse required is also obtained. In this case it is a 100-amp. 250-volt fuse.

In cases where the power is transmitted a very long distance it is not advisable to use a wire as small as Table II allows. This is because the voltage drop on such a wire will be too great. When the distance is very long the size of wire may be determined by the formula underneath Table II, which gives the circular mils required corresponding to a certain voltage drop. If it is known what drop in voltage is allowable at the motor, then the size of the wire can be calculated.

Southwestern Shipbuilding Co. A. G. HUMPHREY,
East San Pedro, Cal. Electrical Engineer.

TABLE I—AMPERES PER TERMINAL FOR INDUCTION MOTORS
For single-phase motor multiply values given for two-phase motor by two.

	Voltage of Motor							
	110		220		250-Volt Fuse	440		600-Volt Fuse
Hp.	Two-Phase	Three-Phase	Two-Phase	Three-Phase	Size (Amp.)	Two-Phase	Three-Phase	Size (Amp)
0.5	3.3	3.7	1.7	1.8	5	0.9	1	5
1	6	6.5	3	3.2	5	1.5	1.6	5
2	10.5	12	5	6	12.5	2.6	3	10
3	15	17	7.5	9	25	3.8	4.5	10
5	27	30	13	15	30	6.5	7.5	15
7.5	....	....	20	22	30	10	11	25
10	....	....	25	29	35	12.5	14	30
15	....	....	35	41	50	18	20	35
20	....	....	48	55	65	24	27	60
25	....	....	54	62	75	27	31	60
30	....	....	70	81	100	35	40	60
40	....	....	95	109	125	47	54	100
50	....	....	110	127	150	55	64	100
75	....	....	165	192	225	83	96	100
100	....	....	215	248	275	108	124	150
150	....	....	320	366	400	160	183	200
200	....	....	410	475	500	205	237	400
250	....	....	510	590	625	250	290	400

TABLE II—ALLOWABLE NUMBER OF DOUBLE-BRAID RUBBER-COVERED WIRES IN CONDUIT

Allowable Current (Amp.)	B. & S. Gage No.	Size of Conduit (Inches)									
		½	¾	1	1¼	1½	2	2½	3	3½	4	4½
15	14	3	6	10	18	28	44	..	..	..	.	..
20	12	..	5	8	12	20	32	..	..	..	..	..
25	10	..	4	6	10	16	26	..	..	..	..	..
35	8	..	..	4	6	8	14	..	..	..	..	..
50	6	..	..	2	4	6	..	..	..	..	..	..
70	4	..	..	..	3	5	..	..	..	..	..	..
90	2	..	..	..	2	3	5	..	..	..	..	..
100	1	..	..	..	..	3	4	.	..	..	..	..
125	0	..	..	..	..	2	4	..	..	..	..	..
150	00	..	..	..	..	..	3	4	..	..	..	..
175	000	..	..	..	..	..	3	4	..	..	..	..
225	0000	..	..	..	..	..	2	4	..	..	..	
240	250,000	..	..	..	..	..	..	3	4	..	..	..
275	300,000	..	..	..	..	..	..	..	4	..	..	..
325	400,000	..	..	..	..	..	..	..	3	4	..	..
400	500,000	..	..	..	..	..	..	..	3	4	..	..
450	600,000	..	..	..	..	..	..	..	2	3	..	..
500	700,000	..	..	..	..	..	..	..	..	3	..	..
550	800,000	..	..	..	..	..	..	..	..	2	4	..
600	900,000	..	..	..	..	..	..	..	..	2	4	..
650	1,000,000	..	..	..	..	..	..	..	..	..	3	..
750	1,250,000	..	..	..	..	..	..	..	..	..	..	3

Size of conductor for given load as limited by voltage drop: Circ.mils = $21.6\ DI \div E$.
D = distance in feet; I = amperes; E = voltage drop; 21.6 = constant.

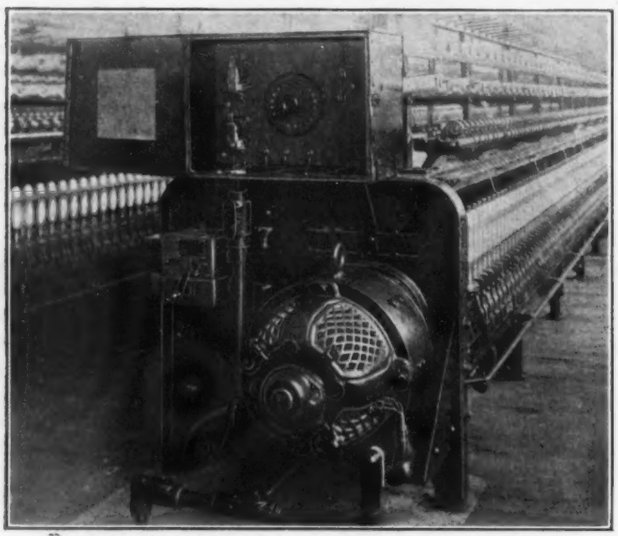
Attractive Transformer Station for Factory Yard

BY LOCATING an inclosed outdoor transformer station away from the main entrance and in a depression on the front lawn, maintaining small shrubs as a growing screen for the fencing and carrying low-tension circuits to the plant in three short runs of iron conduit, a Connecticut wiring-device factory obtains the advantages of an inexpensive installation without marked detriment to the general appearance of the premises. The accompanying illustration shows the sightliness of the substation.

Boston, Mass. FIELD EDITOR ELECTRICAL WORLD.

Silk-Mill Production Aided by Applying Variable-Speed Drive to Twisters

GOOD results are reported from a recent application of variable-speed individual-motor drive to Draper twisters at the New Bedford (Mass.) factories of the National Spun Silk Company, Inc. Instead of utilizing the familiar four-frame drive from a motor mounted above the productive machines and connected with these by belts, each twister is provided with an independent 5½-hp. Westinghouse (type SK) adjustable-speed, direct-current, 250-volt motor, as shown in the accompanying photograph. The motor is compound-wound and a speed range of 500 to 1,500 r.p.m. is obtained by varying the resistance of the shunt-field circuit, twenty-one steps being provided at a control panel mounted in a cabinet at a convenient height by the end of the twister frame. The motor is



SPINDLE SPEED ON THE TWISTERS MAY BE VARIED THROUGH A WIDE RANGE

mounted 8 in. above the floor on a ⅜-in. angle-plate bracket 5 in. wide, 13 in. deep and 13 in. high, with its armature shaft directly coupled to the driving shaft of the twister. About ten times the motor speed is obtained at the spindles, of which there are 240 per frame, so that the speed control gives a wide range of spindle speeds.

Contactor switches are provided on the control panel to cut out armature circuit resistance as the motor speeds up in starting and to short-circuit the shunt-field resistance so as to start on full field strength. The resistance in the armature and full strength of shunt field give maximum torque and minimum speed while starting the motors.

In the operation of these machines the overseer adjusts the motor speed to the requirements of the material being handled, and the machine operative is neither required nor expected to attend to this. With the older method of group-driving four frames from an overhead motor, speed changes are obtainable only at the cost of considerable inconvenience. Pulleys must be changed and belts lengthened or shortened, and several machine-hours may easily be lost in this way. The immediate modification of speed to suit the conditions surrounding production attainable by the variable-speed individual drive is so valuable a characteristic that thirty twisters have already been equipped with these motors and the type of control at the New Bedford plant of the company.

FIELD EDITOR ELECTRICAL WORLD.

Boston, Mass.

How to Join Furnace Electrodes

A VERY important factor in the successful use of furnace electrodes is the method of joining them. When one carbon electrode is joined to another by placing the ends in contact, the electrical resistance of the joint is naturally higher than the resistance of the electrodes themselves. This higher resistance is due to the fact that the contact of the faces is not continuous but is made up of an infinitesimal number of point contacts. A joint compound is used to fill the space between these points, and thus the faces are brought into continuous contact. To be satisfactory the compound must be plastic and adhesive so as to stick to the carbon surface and completely fill the clearance between the electrode and the connecting pin. It must not melt out of the joint when the electrode heats up, as that would impair the conductivity. Some of the manufactured compounds are very good for this purpose.

Tests in actual operation have proved that a joint made up with such compound has only about one-third the electrical resistance of a joint made up with the ordinary molasses and graphite mixture formerly so generally used. It has only about one-sixth of the electrical resistance of joints made up without any compound.

After an electrode has burned down so the top edge of the holder, when in its lowest position, is even with the beginning of the threaded section of the electrode, compound should be rubbed into the threads of the hollow threaded end until they are from one-quarter to one-half filled and there is a layer of compound about ¼ in. thick at the bottom of the hole. In addition, the compound should be rubbed into the threads of the carbon connecting pin for from one-half to three-quarters of its length. The connecting pin should then be screwed into the upper end of the electrode in the furnace until it is firmly seated against the bottom of the threaded hole. If the right amount of joint compound has been used, the connecting pin will be firmly seated and one-half its length will extend beyond the end of the electrode. Joint compound should then be rubbed into the thread of the upper half of the connecting pin and into the thread of the lower threaded section of the next electrode. A layer of joint compound ¼ in. thick should be placed on the upper half of the carbon connecting pin and a similar layer on the upper end of the electrode in the furnace. The sections are now ready to be screwed together.

To pick up the electrode to be joined a hoist pin should be used. It is screwed into the threaded end of the electrode and hooked on the crane hoist or chain falls. The new electrode is then swung into an upright position over the electrode in the furnace. When screwing the electrodes together the lower electrode is held rigidly in the electrode holder while the upper electrode—which is supported on the swivel hook—is turned round and round by means of a band wrench, the upper electrode being lowered as it turns. The electrodes should be screwed together so that joint compound squeezes out between the electrode ends in

a layer about ⅛ in. thick. Then the final tightening is accomplished by one or two quick pulls on the wrench. The electrode holder may now be run up past the joint or connecting zone on the new electrode and furnace operation resumed.

The section of an electrode through which the connecting pin extends is known as the joint or connecting zone. Care should be used never to place the electrode holder so that any portion of it extends into this joint or connecting zone, as such practice is liable dangerously to overheat or weaken the sections, causing them to break and allowing the electrode butts to fall into the bath.

This information was furnished by Frank J. Vorburgh of the National Carbon Company, Inc.

Methods of Handling Heavy Mine Cable Installations

WHERE long lengths of cables weighing 6 lb. or 8 lb. per foot are to be installed in vertical mine shafts the problem of lowering into place requires considerable ingenuity. As cables of this type are infrequently installed a very large expenditure for machinery is not justified. For that reason methods must be worked out using such equipment as is available, and at the same time the question of safety must be considered.

When possible, the cable should be installed in a pipeway or ladder road in preference to a hoisting compartment, as it is thus less liable to injury. However, where a heavily armored cable is installed in a hoisting shaft it will withstand a great deal of punishment without interruption of service. The upper support should be sufficient to carry the total weight of the cable in case the intermediate supports should become loosened. The weight may then be distributed on cleats fastened to the shaft timbers at intervals of approximately 15 ft. to 25 ft. Tap boxes may be installed at suitable points and should be of such type that strains will be transmitted by the tap box to the armor above and below. The lead sheath and armor should be solidly connected electrically around the tap.

For short lengths or light cables, where the total weight involved does not exceed 1,000 lb., a well-braced cribbing under the reel will usually be found a satisfactory method of handling. The braking is accomplished by 2-in. x 12-in. planks bearing against the under side of the drum on one or both sides. The axle upon which the drum revolves must be fastened to the cribbing in such a manner that the reel will not be lifted off the support when the brake is applied. Some method of positive locking of the reel when stopped should also be used. The inside end of the cable on the reel should be fastened very securely before starting, as numerous accidents have occurred owing to the inside end of the cable becoming unfastened and the cable as a whole slipping on the reel. Sometimes a pulley is fastened to one or both sides of the reel and band brakes are applied to these pulleys. This makes a somewhat better arrangement and allows the cable to be fed out more evenly.

Where extremely heavy cables are to be installed the regular hoisting equipment may be employed to advantage. The simplest and safest method is to unreel the cable from the bottom of the shaft by attaching one of the hoisting cables to the end of the power cable and winding in the hoisting cable on the main drum till the power cable has been pulled into position. In this manner the total weight of the power cable is transferred to the hoisting rope as it is unwound from the reel and is held until properly supported and cleated. This method unfortunately cannot generally be applied owing to the reels usually being too large for lowering in the shaft.

A method sometimes used where a heavy cable is to be installed and facilities are not available is to place clamps upon the cable and lower the cable by means of chain blocks or hand winch. The load is transferred to another set of blocks or to a rigid fastening when the blocks had been run out to the limit. This method is slow and laborious.

When a hoist is available the cable may be lowered by attaching the hoisting cable to the power cable by means of clamps at intervals of 25 ft. or 50 ft., carrying the weight on the hoisting cable. The power cable may have some slack at various points, and final adjustments may be necessary after the cable is in place. In some cases the cable has been wound on the main hoisting drum and paid out by the hoist. This may be well in a new shaft, but usually the time involved in removing the hoisting rope and reinstalling will cause considerable delay in regular hoisting operations and as this lost time must also be added to the cost of installation the method will be found expensive for a working shaft.

Careful consideration should be given to the method of clamping the hoisting and power cables in order to avoid damaging either cable. Long special clamps should be used to avoid drawing the U-bolts so tight as to flatten either cable. Damage to the cables may be avoided by filling all openings with short pieces of hoisting cable. In this way the plate does not come in contact with either cable. Where the power cable passes over sheaves under tension they should be of sufficient diameter to avoid damage to the cable. If the tension is sufficient to draw the cable down tightly around the sheaves, the diameter should not be less than fifteen times the diameter of the cable, and preferably larger.

The following methods were used in the installation of cables at two of the shafts under the supervision of the writer:

Shaft Cable No. 1.—Operating voltage, 250 volts direct current; size, 500,000 circ.mil, single conductor; insulation, 3/32-in. varnished cambric; protection, 3/32-in. lead—25 strand No. 8 steel-wire armor; weight per foot of cable, 6 lb.; total weight of cable, 7,970 lb.; vertical height suspended cable, 1,124 ft.; total length of cable, 1,328 ft.; nominal outside diameter, 2 1/16 in.

In this case the cable was delivered at the bottom of the shaft by means of an adit tunnel and was raised from the bottom of the shaft by means of the main hoisting cable. Owing to size and weight, the cable was furnished on two reels. This cable was used as a tie line between the rotary converter station at the collar of the shaft and the rotary converter station at the mouth of the adit. Power was tapped off for lighting at the floor levels at 500 ft., 600 ft., 800 ft. and 900 ft., and at the 700-ft. level for electric haulage and stationary motors.

The cable was raised through the manway by detaching the hoist cable from the cage and dropping it through the manway. The cable reel was mounted and the end of the power cable was attached to the hoisting

cable by four clamps made up of a ½-in. plate, 16 in. x 4 in., with four ½-in. U-bolts. Short pieces of ⅝-in. hoisting cable were placed to fill all openings. The bolts were drawn up snug, but not tight enough to injure the cable. The upper piece of cable was then hoisted into place. The clamps and the lower end of the cable were followed by a man who climbed the manway to see that they did not hang up on the timbers. When the cable was hoisted into place a similar clamp was installed at the top and fastened to the head frame by means of eyebolts. The cable was then held in place down the shaft by means of two-piece cast-iron clamps secured by bronze lag bolts. These clamps were sufficiently tight to prevent the cable from slipping and were approximately 15 ft. apart. When the top piece was securely anchored the lower piece was raised in place and anchored in a similar manner. This portion of the work was completed in two working days, the force being as follows: One electrical foreman, two electricians, two electrical helpers, two timbermen, two timbermen helpers, hoistman and skip tender. The last two were not used continuously, as one cage was operated out of counterbalance when the cable hoisting was not actually in progress. In order to operate at slow speed in raising the cable the hoist was thrown in counterbalance and the weight of the cage on the other rope used to raise the cable.

All tap boxes and cable terminals were installed after the cable was secured in place. The tap boxes were of a type in which the armor is clamped separately from the cover of the box. The weight of the cable below the cut was taken by clamps and eyebolts. The armor was then cut and the cable prepared for the tap. The box was clamped in place as soon as the armor was prepared to receive it. The boxes were mounted vertically. While this method of mounting is not recommended there does not appear to be any serious objection to it and it simplifies the installation greatly.

The negative return line was made up of an old cable already installed the insulation of which had broken down. The lead sheath and armor were solidly connected to the negative line at each end and at each tap box to avoid corrosion due to stray currents. After completion, the entire cable and supports received a thorough coating of asphalt paint.

Shaft Cable No. 2.—Operating voltage, 2,300-volt, three-phase, 60-cycle alternating currents; size, No. 2, 3-cond.; insulation, ⅜-in. varnished cambric and $\frac{4}{64}$-in. v.c. belt; $\frac{64}{64}$-in. lead No. 8 steel-wire armor; weight per foot of cable, 5,625 lb.; total weight of cable, 1,640 lb.; vertical height suspended, 262 ft.; total length of cable, 292 ft.; outside diameter, 2⅛ in.

In this case it was more convenient to drop the cable from the top, a small hoist being available for the work. The power cable was attached to the hoisting cable at intervals of 50 ft. and lowered by the brake drum of the hoist. The shaft has only two compartments, both of which are used for hoisting. Thus it was necessary to use one corner of the hoisting compartment. After the cable was in place it was secured by clamps at 10-ft. intervals. In this case the men worked on a platform on top of the skip. The work of lowering the cable in the shaft was completed in one shift by the following crew: One electrical foreman, four electricians, three electrical helpers, one hoistman, one skip tender.

A similar installation was made at another shaft and the same methods proved satisfactory.

El Paso, Tex. T. H. Arnold.

Scrap Value of Old Storage Batteries

LEAD batteries have a scrap value even after they can no longer be used for storing and delivering electrical energy. In the accompanying table are shown the average amounts of materials which can be salvaged from the elements of two types of "Exide" thin-plate batteries, with the current prices for the materials. These materials are of three kinds—plate lead, strap lead and sediment. When the plates are removed the strap lead is separated from the plate by sawing with a hack saw just above the highest active material of the plate, as indicated in the drawing. The strap lead or alloy is not sold, but is remolded into plate-strap connectors and cell connectors. Used in this way it is worth about 14 cents per pound.

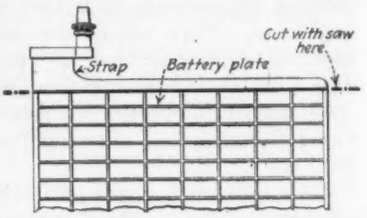


PLATE IS SAWED ALONG HEAVY LINE TO SALVAGE THE SCRAP ALLOY

AMOUNT AND VALUE OF SCRAP MATERIAL FROM STORAGE BATTERIES

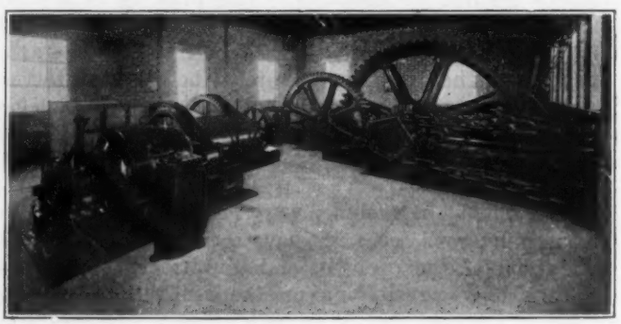
Material Salvaged	Average Amount Salvaged from "Exide" Thin-Plate Batteries, Lb. Thirty-one Plate, Forty-two Cell Battery	Thirteen-Plate, Forty-two Cell Battery	Salvage Value, Cents per Pound
Plate lead	1,730	617	2
Strap lead	189	52	14*
Sediment	175	74	7.5

* Strap lead is not sold; but remelted for connectors, it is worth 14 cents per pound.

MARTIN MELIA,
Engineering Department.
Commercial Truck Company,
Philadelphia, Pa.

Motor Drive for Marine Railway

ELECTRIC driving of marine railways affords close control of ship movement into and out of the water, combined with economical use of power. The accompanying illustration shows the machinery at the railway type dry dock of the Colonna Marine Railway Corporation, Norfolk, Va., where a 4,000-ton vessel can be withdrawn from the water in forty-five minutes. In returning the ship to the water the motor is run as a generator. In this installation a 225-hp., 440-volt, three-phase Wagner motor drives the ship-hauling chains through spur gearing, an automatic brake of the solenoid type being provided to hold the machinery in a fixed position in case the supply of energy ceases. Six 2⅜-in. chains are required for handling each vessel.



DRAWS 4,000-TON VESSEL FROM WATER IN FORTY-FIVE MINUTES

Central Station Service

A Department Devoted to Commercial Policy and Management Topics, Including Methods of Increasing the Use of Electric Light, Power and Heat

"Keeping the Faith" with the Public Is Appreciated

IN VIEW of the attitude of the daily press toward utility companies in former years it is interesting to note an editorial published in the Minneapolis *News* for March 9 under the caption "Keeping a Promise." The comment was on the announced removal by the company of the fuel surcharge placed in effect Sept. 1, 1920, which had been made necessary because of an advance of $3.43 per ton for coal. The editorial read as follows:

"At a time when public utility corporations are generally under fire, with strenuous efforts being made to bring them also under suspicion, it is gratifying to note at least one that voluntarily 'comes across' with a reduction in its rates. Conditions affecting the Minneapolis General Electric Company may be less complex than those affecting other public utility companies; that company may be more fortunate than the others in the reduction of its operating expense, but it none the less deserves credit for passing the reduction in the cost of fuel along to its patrons. By so doing the company has justified the faith reposed in it by the public, which paid a 10 per cent bonus upon the now fulfilled promise that the charge would be suspended if fuel costs fell."

Public Utility Is Essentially a Home Industry

BECAUSE many public utilities are financed largely by out-of-town capital there is a general impression that the electric light and power or any other public service company is something of an alien in the community. That the electric light and power company is essentially a home industry and in actual practice few other businesses pay as much in taxes, furnish as much employment or make larger purchases of material and supplies in the local markets was pointed out by the Portland (Ore.) Railway, Light & Power Company in the following manner:

"It is surprising to see how few people recognize the fact that a large public utility corporation like this company is really a home industry and of great value in developing the community. Probably no institution in Portland has done as much for the upbuilding of the city as has the Portland Railway, Light & Power Company. It has a large army of employees—2,800 in number—many of whom are taxpayers and home owners. Inasmuch as nearly every one of these employees is a breadwinner for a family of several people, our company directly contributes to the support of a population of probably between 12,000 and 14,000 persons.

"The aggregate payroll of this company for the last calendar year was nearly $5,000,000, and about 90 per cent of that great sum goes directly back into the channels of local trade. This company is also the largest individual taxpayer in the community and last year paid out in taxes and public charges almost $800,000.

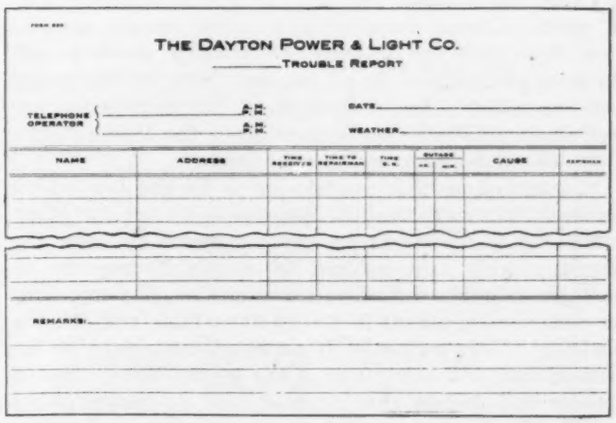
"That this company believes thoroughly in patronizing home industry is evidenced by the further fact that the purchase of supplies and materials by this company in Oregon for last year amounted to $1,345,885. In fact, every item of this character that could be bought locally was purchased here."

Prompt Attention to Trouble Calls Creates Good Will

PUBLIC good will and a reputation for rendering good service have been earned by the Dayton (Ohio) Power & Light Company by its prompt attention to trouble calls. How this work is handled and how the employees have co-operated to make the service efficient is described in the following letter from O. B. Reemelin, general superintendent of the company:

"Recently the Dayton Power & Light Company felt that it could improve the service rendered to its customers when repairs were necessary, especially in the residential districts. We first prepared the trouble report form shown here, which the trouble operator was required to fill out as the calls came in. It will be noted that in addition to the name and address of the customer the form provides spaces for entering the time the call is received, time given to repairman, time "O. K," duration of outage, cause of trouble and name of repairman.

"This report was then used as a means of stimulating the interest of the repairmen by averaging the outages


THE DAYTON POWER & LIGHT CO.

TROUBLE REPORT

TELEPHONE OPERATOR

DATE

WEATHER

NAME	ADDRESS	TIME RECEIVED	TIME TO REPAIRMAN	TIME O. K.	OUTAGE HR.	OUTAGE MIN.	CAUSE	REPAIRMAN

REMARKS:

TROUBLE REPORT USED BY DAYTON POWER & LIGHT COMPANY

each day and showing them the result. The trouble operator was made responsible for the handling of all calls, and he was instructed that if a call was not taken by a repairman in half an hour after its receipt, it should be referred to the head of the department.

"The men in the repair department saw that the com-

pany was taking an interest in their work and immediately commenced trying to break records. As a result there were some remarkable accomplishments in the matter of prompt service. One trouble sheet showed a record of twenty-nine outages the average duration of which was twenty-one minutes.

"Following this the company began receiving words of commendation from its customers. Favorable comments were also received by the repairmen and trouble operators, and in each case the man whose work was thus complimented was notified in order that he might know that his efforts had been appreciated.

"We now have quite a long record of customers' approval, such as, 'When did you start this kind of service?' and 'This is what I call service,' after an outage of twelve minutes. In one instance the repairman reached the location, many squares distant, nine minutes after the lady of the house had reported trouble. Upon hearing him at the door she called out of the upstairs window to see what was wanted and asked how he had arrived so quickly as she had only just come upstairs from calling. One customer remarked after an outage of fifteen minutes, 'That surely is fine service; you don't have to wait on the light boys.' Another after an outage of the same duration said that the Dayton Power & Light Company was the only company giving service.

"In addition, the men now find that they are received with a smile instead of disgruntled remarks, which is an added incentive to giving good service, and they appreciate the value of good service on washing and ironing days in case an electric appliance is out of order.

"We feel therefore that the effort spent in making our department for correcting trouble more efficient has been well worth while and that promptness and efficiency in taking care of trouble calls is a big asset to the company."

Unenviable Position of Public Service Commissions

PASSING a camel through the eye of a needle presents no more obstacles to a public service commission than does the problem of handing down a rate decision satisfactory in all respects both to the public and the utility. The difficulties of the commission are well illustrated in a recent decision by the Maine Public Utilities Commission which said in part:

"Controlled as this commission is by the law which declares that rates shall be reasonable to the customer, influenced as we ought to be by a desire to treat the company with fairness and to enable it properly to perform its public duties, this commission, like any similar commission, stands in a very unenviable and delicate position. Very naturally if rates are sought to be increased each and every user of the service being affected resents and resists the increase, and no matter what may be the facts presented some customers, and oftentimes the majority of the customers, will not be convinced of the necessity or reasonableness of any increase whatever. Facts and figures do not seem to count with some, and perhaps it is no more than to be expected that during these times of high and increasing costs every addition to the burden seems not only unreasonable but unnecessary. Each person hopes and has been hoping that the burdens will be lessened, and any addition is accepted in a resentful spirit. We have been criticised severely during the past three or four years. We shall no doubt continue to be criticised, but we should be unworthy of holding the position we do if the members of this commission were in the least respect swayed either by criticism or by any other improper influence. We have a duty to perform and must perform it with fairness and courage."

Newspaper Points to Necessity of Hydro-Electric Development

CHAMPIONING the cause of hydro-electric development in California, the San Francisco *Chronicle* is regularly devoting space to a self-interest discussion of the power situation throughout the state. In one of a series of articles the consequences of the existing power shortage are placed before the public in a manner which commands attention and urges the co-operation of every resident of the state.

The far-reaching effect of the power shortage is shown by citing a particular case as follows:

"Contractors recently refused to bid on a central California hotel because they could not obtain power.

"A San Francisco firm had the contract for furnishings.

"A Los Angeles firm had the plumbing contract.

"A manager had been chosen.

"Contracts were scattered through the state.

"All plans have been withheld for lack of power.

"Somewhere this affected you.

"Look about you and you can find where the shortage of power hurts you."

Another instance was quoted in this manner:

"A few months ago a Fresno contractor was limited in the use of power to only five hours daily.

"Here is the effect:

"Fifty workers were being paid for an eight-hour day. The majority of these depended on the operation of motor-driven machinery.

"Therefore, almost one-third of his payroll was a total loss.

"The contractor had agreed to a penalty for each day completion was delayed beyond the contract date.

"The contractor's loss, therefore, included one-third of his total payroll and a large additional sum as penalty for delay.

"He lost money on the job and future construction by him will cost more.

"This because of lack of power."

In summing up the problem of hydro-electric development the article says:

"Delaying or postponing hydro-electric development is checking progress in our cities, towns and villages. In helping to foster power development we help to build our own interests, our own comforts. The power companies make new business for the state. They create new wealth. They put money into the pockets of every Californian.

"California has plenty of water power, but mostly going to waste. The development of hydro-electric power in California has boosted industry on every hand. But industry, agriculture and manufacturing, has caught up with its power supplies. If it is to go ahead it needs more power. Force of circumstances as well as economic logic demands that more water power be harnessed. We are obliged to depend upon private

enterprise for this development. Common sense, then, urges that private enterprise be relieved of hampering restrictions and in every way encouraged to go ahead with the development of our water-power resources.

"The situation is not commonly understood. Development now must turn to the big projects on the large streams. These will take a great deal of capital, and this cannot be had unless there is assurance of a fair return and safety for the investment."

California Company's High Percentage of Local Stockholders

ON JAN. 31, 1921, stockholders of the Pacific Gas & Electric Company numbered 15,735, of whom 12,708 held preferred and 3,027 held common stock. The accompanying table shows that 12,305 residents of California, constituting 78.2 per cent of the total number of stockholders, are interested in the company through ownership of its stock alone, aside from holders of bonds and notes. The constantly increasing list of customers and employees who are becoming partners in the enterprise through stock ownership affords an indication of the confidence of the public in the stability and future of this company.

DATA ON STOCKHOLDERS OF PACIFIC GAS & ELECTRIC COMPANY

	Number of Holders Preferred	Common	Total Stockholders Number	Per Cent	Par Value
California	11,177	1,128	12,305	78.2	$42,221,388
Coast and Honolulu, excluding California	209	60	269	1.7	1,089,100
Middle States	297	482	779	4.9	4,297,900
Eastern States	973	1,212	2,185	13.9	19,596,900
Foreign	52	145	197	1.3	2,173,800
Total	12,708	3,027	15,735	100.0	$69,379,088

The total number of the company's security holders at this time exceeds 40,000.

Indiana Company Sells $500,000 of Stock to Its Customers

ANOTHER instance of the possibilities of customer ownership of electric light and power companies is shown in the recent sale by the Interstate Public Service Company, Indianapolis, Ind., of $500,000 of its 7 per cent prior lien stock to customers of the electric, gas and interurban properties operated by the company. Commenting on the success of the sale, Harry Reid, president of the company, said:

"In spite of the fact that the money market has been described as tight, and stocks and bonds generally have not been absorbed as rapidly as in normal times we have sold approximately $500,000 worth of our 7 per cent prior lien stock. The people of this state have money to invest and will put it in sound, profitable investments.

"Our company is naturally pleased to find that its customers have enough faith in it to place some of their savings or surplus funds with us. It makes them partners in the enterprise. It seems to me that this partnership relation will be beneficial both to the company and to its patrons. The public utility business is really the people's business, anyhow, and the closer the relationship between the companies and the people the better it will be for both."

The stock was sold at par and handled entirely by the employees in the various branch offices of the Interstate Public Service Company.

Daylight Lamp Increases Production of St. Louis Factory

DURING the heavy demand for paint last year one manufacturer in St. Louis could not produce enough colored paint because of inability to distinguish the colors at night. A "daylight" gas-filled lamp was installed at the suggestion of the central station, and the manufacturer found that all colors except light brown could be exactly matched by comparison with the standard under the light of this lamp. After a little practice the men were soon able to match the light-brown colors also, and the factory was then placed on a twenty-four-hour basis. The manufacturer was thus enabled to meet his demand, and the revenues of the central station were correspondingly increased.

Tying in Local Advertising with National Good-Will Publicity

AS A MEANS of supplementing the national campaign for public utility good will, the Tampa (Fla.) Electric Company has reproduced the N. E. L. A. advertisement which appeared in the *Saturday Evening Post* for March 5. As shown in the accompanying cut, the good-will advertisement was used as a part of one of the company's regular newspaper advertisements. This use of general publicity effectively puts the problems of the local utility before the public which it serves, and adds strength to the national campaign.

Electricity—the Modern Genii In the Home
Instead of rubbing the magic lamp, as in days of old, the present-day housewife need only press the electric button, and lo and behold! much of the drudgery and worry of home-keeping vanishes!
Housecleaning With the Hoover Electric Suction Sweeper
It beats,
—as it sweeps
—as it cleans
—as it straightens nap
—as it revives coloring
—as it saves rugs and carpets
Only the Hoover does all this, and it is the largest-selling cleaner in the world.
We will gladly demonstrate in your home on your rugs.
Convenient terms.
Ironing With An Electric Iron
The time saved in walking back and forth and the always even, "just-right" heat of the Electric Iron has convinced many people that to "Do It Electrically" is to do it right! Have you a three-pound iron for those dainty things?
6-lb. Household Irons
Westinghouse $7.00
Hot Point $8.00
American Beauty $10.00
3-lb. Boudoir Irons
From $6.50 and up.
The Street of Happy Lamps
NATIONAL ELECTRIC LIGHT ASSOCIATION
Washing With the Western Electric Washer and Wringer
It saves
Time
Work
Worry
Clothes and
Money.
—And it cleans clean!
As good as any.
And better than many.
Ask your neighbor.
With Stationary Wringer $125
With Swinging Wringer $137
Convenient terms.
Sewing With the Western Electric Sewing Machine
It is easy to sew with—easy to carry—easy to put away.
Dainty garments are made much more quickly when electricity does away with the tiresome pedalling, for it is no longer necessary to stop every now and then to give the tired back and feet a rest.
We will send one to the house and let you try it.
Convenient payments.
Tampa Electric Company
Tampa and Cass Streets
Commercial Department
Phone 2661

USE OF NATIONAL GOOD-WILL PUBLICITY IN LOCAL ADVERTISEMENTS

Digest of Electrical Literature

Including Brief Abstracts of and References to Important Articles Appearing in the Scientific and Engineering Press of the World

Generators, Motors and Transformers

Calculation of the Dissipation of Heat in Transformers.—M. VIDMAR.—Quoting from a chapter of a recently published book by the author on "Transformers," a method of calculating the heat dissipation of transformer windings and transformer tanks is given. The formula is derived from the fundamental Stephan-Boltzmann law on heat dissipation. The proper use of the formula is illustrated as applied to an actual, air-insulated, disk-coil transformer stack. —*Elektrotechnik und Maschinenbau,* Feb. 6, 1921.

Longitudinal and Transverse Heat Flow in Slot-Wound Armature Coils.—CARL J. FECHHEIMER.—Formulas for transverse and longitudinal heat flow in armature coils are worked out and checked by test results. Tests were made on a 2,400-volt, three-phase, 60-cycle, 3,600-r.p.m. turbo-generator. There is a close agreement between calculations and test for maximum temperature, minimum temperature and temperature at the end of the core, the exception being the maximum temperature at no load. It is said that there is slight difference between the calculated minimum temperature considering transverse flow only and the minimum temperature by tests. On the other hand, there may be a large difference between the calculated maximum temperature considering transverse flow only and the maximum test temperature. Thus it may be misleading even in medium-length machines to ignore the longitudinal flow. One of the principal differences between tests and calculations appears in the no-load curve. Evidently with I^2R and eddy current loss in the copper, some heat from the iron flows transversely from the iron to the copper and is transmitted longitudinally to the end coils, where it again flows transversely to the coil surface.—*Journal A. I. E. E.,* March, 1921.

Lamps and Lighting

Searchlamps with Several Light Sources.—I. KIEFER. —A new patented method is described by means of which it is possible to build searchlamps of unlimited light power by using more than one source of light. The individual lights have each their own, relatively small, ellipsoidal or parabolic reflector, all concentrating their light into one main beam. Arrangements with six and eight lamps are diagrammatically shown. Among other advantages the undisturbed service of the searchlamp is emphasized in case one of its components should fail.—*Elektro Journal,* January, 1921.

Generation, Transmission and Distribution

Powdered-Coal Firing for Electric Power Stations.—FRIEDRICH MÜNZINGER.—A detailed and analytical article on the different systems and methods used for pulverizing the coal, for feeding the powder to the boilers, and for burner construction, always with special reference to large power houses. The good experience and the wide use of such firing systems in America and England lead the author to recommend it for more general use in Germany.—*Elektrotechnische Zeitschrift,* Feb. 3, 1921.

Plants of the Chilean Exploration Company at Tocopilla and Chuquicamata.—M. NEUSTATTER.—A detailed and well-illustrated article on the power transmission plant of the Chilean Exploration Company, built by Siemens-Schuckert in Berlin for the production of electrolytically pure copper from the ores in Chile. The power station at Tocopilla is situated at the seashore. The electrolytic works are 140 km. distant at an altitude of 2,700 m. The power station has a capacity of 40,000 kva. and transmits its power at 110,000 volts. A battery of sixteen B. & W. oil-fired boilers feeds four steam turbines of 12,500 kw. each. The generators are rated at 9,000 kw. at 0.9 power factor, 5,000 volts, 50-cycles, 1,500 r.p.m. Four main transformers of 10,000 kva., three-phase, each, with oil conservators and externally cooled oil, raise the voltage to 110,000. Each transformer contains 16 tons of oil. A detailed description of the switchgear is given. At the receiving station four similar transformers step from 100,000 volts down to 5,000 volts, driving seven motor-generators of 2,500-kw. direct-current output each. Four of these units are induction-motor-driven and three are synchronous-motor-driven, each unit consisting of one alternating-current motor and two direct-current generators. A complete wiring diagram of the receiving station, details on the chemical processes, and many data on the difficult transmission line conclude the paper.—*Elektrotechnische Zeitschrift,* Jan. 6, 13 and 20, 1921.

Economy of Electric Flatirons.—R. NAUJOKS.—The article presents the report of an exact test of five different types of German electric flatirons. From the tests are derived some general directions for the most efficient and economical construction of flatirons.—*Elektrotechnische Zeitschrift,* Jan. 20, 1921.

Traction

New Theories on the Vibration Phenomena of Electric Locomotives with Rod Drives.—A. WICHERT.—This long and very detailed article gives a mechanical analysis and criticism of observations and data made by seven different European authors on the very complex problems of vibrations of rod-driven electric locomotives. The author of the paper has endeavored to familiarize the reader with interesting viewpoints taken by the different writers in their attempt to analyze and remedy dangerous vibrations on rod drives. He invites all engineers familiar with such types of locomotives to add their experiences and to help thereby to solve a problem which causes considerable trouble and is receiving little attention.—*Elektrotechnische Zeitschrift,* Feb. 3, 10 and 17, 1921.

Electrolysis Mitigation in Winnipeg.—W. NELSON SMITH.—A three-wire system has been applied to bring

ground-return conditions of the Winnipeg Electric Railway into conformity with the electrolysis act passed by the Legislature of the Province of Manitoba. A discussion of what has been done to date and why the various measures were taken.—*Electric Railway Journal*, March 26 1921.

Installations, Systems and Appliances

Control of Crane Motors by Bergmann System.—E. BLAU.—The control of the traveling and cross-traveling motors on multiple motor cranes may be achieved safely and satisfactorily by simple drum controllers, with few steps. The main lift motor should have a wide range of speeds, permitting a finely adjustable control. This is usually achieved to some extent by cutting resistance into the direct-current series motor or the slip rings on an alternating-current motor. Obviously this is an energy-wasting method, and the amount of current to be handled on large cranes does not permit of many fine steps, if the bulk of the controller is to stay within reasonable limits. The Bergmann system results from some modifications of the Leonard principle, wherein a motor-generator the voltage of which is easily regulated feeds the main direct-current lift motor. The advantages of this system are explained, emphasis being placed upon the ease and simplicity of wide-range speed control. The controller for a lift motor of several hundred horsepower, for example, has to carry only about 1 hp. to 2 hp. of power. A complete wiring diagram is reproduced.—*Elektrotechnik und Maschinenbau*, Jan. 16, 1921.

High-Speed Circuit Breakers.—G. G. GRISSINGER.—A high-speed air-break circuit breaker is described the purpose of which is to open an electric circuit, after a short circuit occurs, so quickly that the current will be unable to reach a dangerously high value. Such breakers are particularly applicable when applied to railway or similar heavy-duty service in which the converter or motor-generator set is called upon to carry sudden and heavy overloads or short circuits, thus, unless suitable protection is provided, destroying the commutating parts of the machine.—*Electri Journal*, February, 1921.

Electrophysics and Magnetism

Formation of Negative Ions in Air.—LEONARD B. LOEB.—The purpose of experiments described by the writer was to decide between the two theories of the formation of negative ions proposed by Wellisch and by J. J. Thomson. The curves were found to agree in general with the results of previous investigators and that they show anomalous mobilities below a critical pressure which was found to vary with the frequency of commutation of the emf. No "free electrons" of the Wellisch type were observed.—*Physical Review*, February, 1921.

Theory and Calculation of Variable Electrical Systems.—JOHN R. CARSON.—Variable electrical systems are defined as those in which either the circuit elements (resistance, inductance or capacity) are explicit time functions or those in which the relation between current and applied emf. is non-linear. In the present paper the theoretical methods of solution of "invariable systems" are extended to include variable systems by integral equations of the Volterra type. A number of representative problems are worked through to indicate the appropriate mathematical procedure and the applicability of the method to both transient and steady-state phenomena.—*Physical Review*, February, 1921.

Units, Measurements and Instruments

Measurement of the Electromagnetic Field of Transoceanic Radiographic Waves.—C. VALLAURI.—During the summer of 1919 the wireless station at Annapolis carried out experimental transmission tests lasting for twenty-four hours continuously. The Italian Royal Naval Electrotechnical and Radiotelegraphic Institute took the opportunity to make a quantitative measurement of the electromagnetic field at the receiving station. A table is given showing the results of these tests, and the method of making them is also described. —London *Electrician*, Feb. 25, 1921.

A Precision Form of the Kelvin Electrostatic Voltmeter.—E. H. RAYNER.—The paper describes the form of electrostatic voltmeter for precision measurements. This instrument follows the general arrangement of the Kelvin type. The chief modifications are (1) very considerable reduction in weight, permitting (2) the use of a bifilar suspension to overcome the effect of elastic fatigue, (3) a modification of the shape of the needle to produce a more satisfactory "scale law" for both small and large deflections, and (4) the provision of various mechanical details to facilitate construction and adjustment.—*Journal Institution Electrical Engineers*, London, January, 1921.

Telegraphy, Telephony and Signals

Loud-Speaking Telephones.—PHILIP R. COURSEY.—A short discussion of the arrangement and construction of loud-speaking telephones.—*Wireless World*, Feb. 19, 1921.

High-Power Radio Station at Nauen—II.—FELIX LINKE.—The Nauen station operates with four fundamental wave lengths of 16.8, 12.6, 8.4 and 6.3 km., according to a periodicity of 18,000, 24,000, 36,000 and 48,000 cycles. The efficiency of the plant, based upon continual, not telegraph, load is from 66 to 53 per cent, depending on wave length used. The highest antenna voltage permissible is about 100 kv. The power factor in the antenna using long waves is about 0.01. Great difficulties had to be overcome in the design of a reliable telegraph key capable of making and breaking on the average 320 amp. at 1,900 volts twenty times per second. A number of series copper contacts, cooled by compressed air from a 1-hp. blower, solved the problem. The contacts must be renewed after every three or four weeks of operation. The speed regulation of the high-frequency generator is kept within 0.18 per cent. A detailed description of the huge A and B antennas are given. The A antenna is supported by two towers 260 m. high and four towers 120 m. high. The B antenna consists of two 150-m. towers and one 134-m. tower. The characteristics of the two antennas are: Own frequency, A antenna, 4,800 m., and B antenna. 3,400 m.; static capacity, A, 28,000 cm., and B, 16,000 cm.; total resistance, A, 3.8 ohms, and B, 2.8 ohms; number of wires, A, 10, and B, 16. An idea of the output of the Nauen station may be gained from the fact that during nine months of 1917 a total of 3,680,000 words were sent out from there. The station has had a range capable of covering the entire globe since 1918. —*Zeitschrift des Vereines Deutscher Ingenieure*, Vol. 64, page 1,003.

Scientific and Industrial Research

(PRINTED IN THE THIRD ISSUE OF EACH MONTH)

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available, and Suggestions for Co-operative Work.

Conducted by PROF. VLADIMIR KARAPETOFF
Cornell University, Ithaca, N. Y.

Research in Progress and Completed

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited appeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

AUDION BULB, OXIDE-COATED, PHOTO-ELECTRIC EFFECT IN.

It was observed that the oxide-coated filament in high-vacuum audion bulbs showed slight photo-electric effect, both heated and when cool. When the plate element was made positive an increase in action was found. It was found that the active material was a brownish deposit on the plate and that this active material was a mixture of the elements barium, strontium and possibly calcium. The action is immediately destroyed if a trace of oxygen is admitted.—*T. W. Case, Auburn, N. Y.*

CORDS, ELECTRIC HEATER, TESTS OF.

Information is now available concerning the durability or wearing quality of various makes of heater cords on the market. The principal tests made with the view of establishing a standard of quality for such articles were bending tests and abrasion tests. The copper conductor of the cord is more susceptible to wear from bending and the insulating covering to wear from abrasion. Tests were also made on the principal types of cords with a view of determining the inflammability of various insulating mediums used and the effect of braiding and stranding on the resistance of the copper conductor. A table of relative durabilities was also compared to a similar table based on the experience of practical electric wiring men who had used the various makes of cords.—*Wiring Committee, N. E. L. A.*

CURVES, PARABOLIC AND LINEAR, ADJUSTMENT OF.

Least-squares reductions of observations that follow a parabolic or linear law, taken at equal intervals of the independent variable, frequently occur in physics and engineering practice. Makeshift devices are often employed to evade the arithmetical work in such reductions. The least-squares formulas have been subjected to mathematical treatment and rigorous solutions evolved which require an ultimate minimum of arithmetical work. A table has been constructed from which a large portion of the solutions of such problems may be written down from inspection of the observations. Applications of this method to typical problems have been made, and shown to check absolutely with the least-squares solutions.—*Bureau of Standards, Washington, D. C.*

FERRO-NICKEL ALLOY OF CRITICAL PROPERTIES.

Extensive experiments have shown that the 35 per cent nickel-iron alloy, corresponding to the composition Fe_2Ni, has physical properties more or less markedly different from the other ferro-nickels. When various physical characteristics are plotted as a function of the composition the following general facts are brought out: The melting point curve shows a maximum, specific heat a maximum, thermal conductivity a minimum, thermo-electric power a minimum, specific resistance a maximum and temperature coefficient of resistance a minimum.—*L. R. Ingersoll, University of Wisconsin, Madison.*

FURNACE, ELECTRIC, VACUUM-TYPE.

An electric vacuum furnace has been developed which produces temperatures sufficient to melt platinum, iridium, slags and refractories. Some of its various uses are: Preparation of metals, alloys and compounds; determination of melting points by an optical pyrometer or by reference to the furnace calibration curve; calibration of optical pyrometers; distillation of refractory substances for separation or purification, and study of the equilibrium of reactions depending on the pressure of the gaseous phase. The furnace comprises an electric heater inclosed in a vacuum chamber and is made in two types, vertical and box, for varying capacities. A two-stage rotary oil-sealed pump has also been developed for use in producing the vacuum for this type of furnace.—*Research Laboratory, General Electric Company, Schenectady, N. Y.*

MAGNETIC AND MECHANICAL PROPERTIES OF STEEL. CORRELATION OF.

Extensive tests have been made on nickel steel, chrome nickel steel, carbon tool steel and Swedish chrome file steel, for the purpose of discovering some relationship between their magnetic and mechanical properties. The magnetic data were obtained by use of the Fahy Simplex permeameter and included the maximum flux density at $H = 150$ ampere-turns per centimeter, the residual flux density and the coercive force. The mechanical tests included the usual Brinell hardness test, tensile strength, elongation and percentage of reduction in area. A definite relationship has been found between the area of the hysteresis loop and the Brinell hardness or tensile strength, depending on the precise nature of the heat treatment. Thus magnetic measurements offer a satisfactory method of testing and inspection of finished or partly finished steel parts without destroying the material or having any permanent effect upon it. No other known successful method of testing possesses this important advantage. Magnetic testing enables the steel maker to draw distinctions between steels where the present methods of test fail to make sufficient differentiation. The possibilities of magnetic analysis in the examination study and duplication of products which have given exceptional performance in actual service are apparent.—*N. J. Gebert, New York City.*

PHOTO-ELECTRIC CELL STRONTIUM.

A photo-electric cell has been developed using metallic strontium in high vacuum as the active element. The cell gives a current of approximately 100 micro-amperes in average sunlight and may be used to actuate an automatic recording potentiometer. The cell is not subject to injury by sunlight and has remained for three or four months without variation except for a slight deviation about a constant mean. The photo-electric effect does not vary more than 2 per cent for a range of 0 deg. to 100 deg. Fahr. The photo-electric current is proportional directly to the light intensity to which the cell is active when used with a voltage of over 170. Some suggested practical uses are: for obtaining continuous and permanent records of outdoor light conditions, for high intensity photometry for controlling artificial illumination by relay, for measuring light intensity in photography and for the determination of the quantity of light necessary to fade dyes or for any other light-quantity determination.—*T. W. Case, Auburn, N. Y.*

RADIO CURRENTS FOR ORE DETECTION.

An investigation is being carried on with the view of devising a method for the detection of bodies of copper sulphide ore by the use of radio currents of audible frequency. The work so far has given promise of success.—*Paul Cloke, Tucson, Ariz.*

SPEED INDICATOR, STROBOSCOPIC.

A new stroboscopic speed-indicating device has been perfected. The stroboscopic disk is used in conjunction with a neon tube, the discharge through which is controlled by an electrically driven tuning fork.—*Tinsley & Company, London, England.*

Suggestions for Research

ARC LAMP, HIGH-CURRENT TYPE.

The efficiency is increased by increasing the current density in the carbon. Usually it is not possible to secure a smooth, steady and silent arc with a greater current density than, say, 0.15 amp. per square millimeter of the cross-section of the positive carbon. However, if the arc is concentrated by the action of external magnetic fields the current density may be greatly increased. One device which has been tried out with some promise of success consists of a framework of metal bars surrounding the arc. The arc current is made to pass through this framework, and the constant magnetic field so formed tends to concentrate the arc in the center of the system. (See *Journal I. E. E.* (British), Vol. 58, p. 651, 1920.) Other methods are devised for increasing the efficiency and the stability of the arc. Searchlamps and floodlamps may be made much more effective if some means is found which is not too complicated.—*Editorial Suggestion.*

CIRCUIT BREAKERS, CONTACT CONSTRUCTION.

Philip Torchio has shown the importance of so shaping the contacts that the mechanical forces due to the large current at the first instant of a short-circuit tend to press the contact surfaces together rather than to separate them. This allows the necessary time for the tripping mechanism to act and prevents premature destructive arcing (*Journal A. I. E. E.*, 1921, page 120). A theoretical and experimental investigation is desired of the general nature and magnitude of such forces in order to furnish the designer with the necessary data. Tests should be preferably conducted on small models and with much smaller currents than Torchio's, using direct current in order to be able to measure the forces more readily and to observe the effect upon the parts of the switch.—*Editorial Suggestion.*

FUSES FOR POTENIAL TRANSFORMERS.

Extensive tests indicate that most potential fuses on the market cannot satisfactorily open the circuit without a resistance in series (Torchio, *Journal A. I. E. E.*, 1921, page 130). Tests and a theory are desired to determine the best value of the protective resistance for different voltages, and the most convenient and economical construction of resisters, keeping in mind the limitations in space, the necessary distances between adjacent resisters, etc.—*Editorial Suggestion.*

WAVE FILTERS, MADE OF COILS AND CONDENSERS.

Such filters are made up of elements having (a) coils in series and condensers in shunt, allowing only currents below the natural frequency of the line to pass; (b) condensers in series and coils in shunt permitting only currents above the natural frequency of the line to pass, and (c) a combination of the two, with both coils and condensers in shunt or series, permitting the passage of frequencies within a definite range. Wave filters of this kind are useful in alternating-current measurements, as artificial lines, and in telephony and wireless telegraphy for the elimination of interference. On the other hand, they may lead to considerable errors when used in the study of steep-front waves and other transient phenomena in transmission lines. A further experimental and theoretical study of their properties is desired. As a starter see "Archiv für Elektrotechnik," Vol. 8, p. 61, 1919.—*Editorial Suggestion.*

X-RAY TUBES, EXCITING CURRENT FOR.

A more efficient method of exciting X-ray tubes is desired. The ideal current for such work consists of impulses of extremely high voltage but of very brief duration, yet sufficiently sustained to have an appreciable time factor.—*R. Morton, London, England.* (N. B.—There is some controversy as to whether any part of the exciting current except the peak has a function in X-ray work. An investigation along this line, together with improvement in high-tension transformers, ought to produce a more efficient X-ray current.—EDITOR.)

News of the Industry

Chronicle of Important Events and General Activities in the Technical, Commercial and Manufacturing Fields With Announcements and Reports of Association Meetings and Conventions

New Jersey Public Service Holds Successful Vehicle Show

DURING the week the Public Service Electric Company has been conducting a very successful electric vehicle show at its big showroom in Newark, N. J. Road trucks, industrial trucks, passenger cars, storage batteries and charging apparatus and accessories were displayed without cost to the exhibitor for rent or energy. No admission fee was charged to the public. Between two and three thousand people visited the show daily, according to O. J. Lange, general electric vehicle representative of the company, who had charge of the show. A number of novelties were demonstrated in a way to attract the public.

"Leads" concerning a large number of prospective customers were obtained by the manufacturers, and quite a few sales were closed on the floor. Toward the close of the show the exhibitors held an informal luncheon, at which time there were many expressions of confidence in the future of the electric vehicle.

Following is a list of the exhibitors:

Commercial trucks—Commercial Truck Company, Oneida Truck Company, Walker Vehicle Company, Ward Vehicle Company.

Passenger cars—Rauch & Lang.

Industrial trucks—Automatic Transportation Company, Baker R & L Company, Crescent Truck Company, Hoagland-Thayer Company, Industrial Truck Company, Karry Lode Industrial Truck Company, Lakewood Engineering Company, Mercury Manufacturing Company, Terminal Engineering Company.

Battery manufacturers—Edison Storage Battery Company, Electric Storage Battery Company, General Lead Battery Company, Philadelphia Storage Battery Company.

Charging apparatus and accessories—Auto Electric Devices Company, Cutler-Hammer Manufacturing Company, Westinghouse Electric & Manufacturing Company, L. Bamberger & Company.

State Ownership of Water Powers Killed in Maine

BY A VOTE of 18 to 10 the Maine Senate last week killed the proposed constitutional amendment initiated by Governor Baxter to provide for the conservation, storage, control and use of waters and the development, improvement, transmission, utilization, electrical interconnection, control and sale of water powers by the state. In this action the Senate concurred with the House, which had adopted the adverse report of a majority of the judiciary committee against the submission of any constitutional amendment whatever. A minority of the committee suggested a new draft of the amendment providing generally for state control and assistance in storage matters and completely cutting out the taxation suggestions of the Governor.

Sentiment against state control and development has been strong in Maine for some time, following extended presentations of the efficient development accomplished by privately owned utilities under public regulation. At the recent hearing before the judiciary committee on the proposed amendment resulting from Governor Baxter's special message favoring state development, Walter S. Wyman, general manager Central Maine Power Company, argued against the measure on the ground that the hydro-electric interests now serving the people are taking care of every demand for energy in the state. The agitation for state development, he said, is a threat against the people who have in such large numbers invested their savings in public utility securities.

B. F. Cleaves, executive secretary of the Associated Industries of Maine and chairman of the Maine Public Utilities Commission, speaking for the former body, opposed state development and ownership, pointing out that precipitate action toward that end would be a step of extreme gravity. He questioned whether the authority exists to place a tax upon energy generated within the state to be transmitted outside solely because this would be an interference with interstate commerce.

Cities Cannot Enforce Low Rates on Contract Theory, Supreme Court Holds

PUBLIC utilities won unqualified victories when the Supreme Court of the United States on April 11, in one case, reversed the decree of a lower court which had upheld the municipal authorities in their efforts to enforce rates which were confiscatory and in another case upheld a lower court in preventing a municipality enforcing a confiscatory maximum rate. The first case was brought before the Supreme Court on appeal by the Southern Iowa Electric Company, and the second case was brought by the city of San Antonio, Tex., against the San Antonio Public Service Company. These cases have excited wide attention during their course through the courts. In the Iowa case the court holds that it is demonstrated conclusively that the lower court was in error in attempting to enforce rates upon the theory of the existence of a contract.

"The necessity for this conclusion," reads the opinion of the court, "becomes doubly manifest when it is borne in mind that the right here asserted to contract in derogation of the state law and of the rule of public policy announced by the court of last resort of the state is urged by municipal corporations whose every power depends upon the state law."

The Iowa Company has been supplying gas and electric service to various municipalities under long-term franchises, which stipulate a schedule of maximum rates. After the franchises had been in effect a few years suits were brought by the company against three cities to prevent the enforcement of these maximum rates because they were too low and amounted to confiscation. The matter dwindled down to the right of cities to enforce ordinance rates specified in contracts without reference to confiscation. The lower court up-

held the right of a city to make contracts and entered decrees enforcing the old rates, whereupon the companies filed an appeal.

The Supreme Court also held that the question hinged on the contract-making power of the utility, with the result as above reported. In arriving at its decision previously quoted the court said:

"Two propositions are indisputable: (a) That although the government agency having authority to deal with the subject may fix and enforce reasonable rates to be paid public utility corporations for the services by them rendered, that power does not include the right to fix rates which are so low as to be confiscatory of the property of such corporations, and (b) that where, however, the public service corporations and the governmental agencies dealing with them have power to contract as to rates and exert that power by fixing by contract rates to govern during a particular time, the enforcement of such rates is controlled by the obligation resulting from the contract and, therefore, the question of whether such rates are confiscatory becomes immaterial.

"It follows, if the rates here involved are conceded to be confiscatory, they cannot be enforced unless they are secured by a contract obligation. The existence of a binding contract as to the rates upon which the lower court based its conclusion is, therefore, the single issue upon which the controversy depends. Its solution turns first upon the question of the power of the parties to contract on the subject and, second, if they had the power, whether they exercised it."

In the San Antonio case the Supreme Court affirmed the action of the lower court in enjoining the city from enforcing a 5-cent fare. The lower court contended and the Supreme Court concurs that the right to enforce such a rate was not gained by the city by contract and that such enforcement was beyond the power of the city because it would mean confiscation.

The court points out that the Texas constitution prohibits "any irrevocable or uncontrollable grant of special privileges." The court rules that it is clear that the right to regulate gives no power whatever to violate the constitution.

Big Advertising Program for Chicago Electric Vehicle Show

COMPLETE co-operation with the sponsors of the Chicago Electric Vehicle Show, to be held during the National Electric Light Association convention, was promised at a meeting of exhibitors held at the Hotel Morrison on April 6. The show is being given by the Commonwealth Edison Company and the Electric Vehicle Section of the N. E. L. A. At the meeting of the exhibitors it was decided to make an advertising appropriation in addition to that by the Edison Company large enough to give extensive publicity to the advantages of the electric vehicle. Eric W. Swift, assistant superintendent of advertising of the Commonwealth Edison Company, was appointed head of a committee to determine the best method of getting the facts before the public.

Space for approximately twenty exhibitors has been arranged for in the Clark Street appliance showroom of the Commonwealth Edison Company. Reservations have been made by the following companies: Walker Vehicle Company, Ward Electric Truck Company, Commercial Truck Company of Pennsylvania, Oneida Truck Company, Electric Truck Company, Mercury Truck Company, Milburn Electric Company, Detroit Electric Car Company, Rauch & Lang, Baker R & L Company, General Electric Company, Westinghouse Electric & Manufacturing Company, Edison Battery Company, K. W. Battery Company, Edison Storage Battery Company, Philadelphia Battery Company, Schaefer Brothers, and O. P. Smith & Company.

Electrical Refrigerating Show Draws Crowds

The second of the special monthly shows held by the New York Edison Company took place last week and was devoted to electrical refrigerating equipment, both commercial and domestic. The pictures show only portions of the show, which was participated in by a dozen manufacturers. As indicated in the picture on the left the show was well attended, about five hundred people a day viewing the exhibits. The show was held without expense to the exhibitor.

Conference Club Discusses Financing of Labor Board

A MEETING of the Conference Club with members of the International Brotherhood of Electrical Workers was held in Washington March 23 to discuss financing of the National Council on Industrial Relations. There was some question as to whether the National Association of Electrical Contractors and Dealers would continue to give financial support to the council. It was finally voted, however, that no outside organization be asked to take over this burden but that the members of the contractors' association be appealed to individually to contribute to the support of the council, the funds to be administered by the association.

The executive committee of the Conference Club was increased to seven members, and the following were elected: L. K. Comstock, T. P. Curtis, G. M. Sanborn, J. G. Livingston, W. C. Peet, J. A. Cole and B. H. Bendheim.

Will Purchase Surplus Hydro Power in Effort to Cut Generating Costs

TWO large California central-station companies, the Great Western Power Company and the Pacific Gas & Electric Company, which are both requesting the California Railroad Commission to grant them permission to continue the 15 per cent surcharge on their rates previously sanctioned, have, at the instance of the commission, entered into a power-use agreement which the commission thinks will be of advantage to their customers and which Commissioner Devlin declared would have an important bearing on the consideration of the surcharge applications. The agreement is to cover delivery by the Great Western Power Company to the Pacific Gas & Electric Company of hydro-electric power generated at the Caribou plant of the Great Western company for which the latter has no market at the present time. The Pacific company has not enough hydro-electric energy to meet the demands upon it and is forced to use steam plants burning oil to generate electricity, thereby adding to the cost of power to the consumer.

The commission's order followed a declaration by its assistant chief engineer that the completion of the Great Western company's Caribou project on the Feather River about July next would give that company in excess of 100,000,000 kw.-hr. of hydro-electric energy for which it would be forced to go out and find a market, while the Pacific company, pending completion of its own hydro-electric projects on the Pit River, would be forced to use steam-generated electricity to meet the demands of its consumers. According to Power Administrator H. G. Butler, who was present at the conferences between representatives of the two companies, it was agreed that the Pacific company is to the extent of the present interconnections to take surplus hydro-electric energy from the Great Western company in so far as it can displace steam therewith. Mr. Butler said it was the joint estimate of the two companies that during the remainder of the year 30,000,000 kw.-hr. could be taken over the present interconnections. It was further estimated that the Great Western company would have an additional surplus of 28,000,000 kw.-hr.

Mr. Butler announced that it has further been agreed between the companies that the most efficient steam plants of both companies available and adequate for the purpose will be operated on joint account and that the operation of steam plants will be reduced to a minimum.

N. E. L. A. and Power Commission Agree on Water-Power Regulations

AFTER nearly three weeks of discussion, representatives of the National Electric Light Association and O. C. Merrill, the executive secretary of the Federal Power Commission, have reached an agreement as to proposed amendments of the regulations promulgated for the administration of the water-power act. The amendments will be laid before the Federal Power Commission at its next meeting. The final suggestions relate not so much to changes in principle as to the manner of application in order to avoid conflicts and duplications between the state and the federal commissions. It was agreed that the regulations had to be sufficiently general to cover industrial users of power and public utilities not under state regulation. Most of the changes provide exceptions for regulated utilities.

The proposed amendment with regard to depreciation reserves would change the section with regard to general requirements so as to read as follows:

In order that adequate provision may be made for all necessary renewals and replacements of project works and for the maintenance thereof in a condition of repair adequate for the purposes of navigation and for their efficient operation in the development and transmission of power, the licensee shall establish and maintain adequate depreciation reserves and, except as provided in Section 6 hereof and in Section 3 of Regulation 20 hereof, shall conform to such rules and regulations as the commission may from time to time prescribe for accounting for or reporting depreciation, for the classification of property for such purposes, for determining the rate or amount of depreciation to be accounted for or reported on each unit, class or group of property, and for the establishment and maintenance of depreciation reserve accounts.

The new Section 6, dealing with conflict with requirements of state commissions, reads as follows:

When the licensee is a public service corporation or a person, association or corporation developing, transmitting or distributing power for sale or use in public service, and such licensee is subject to the jurisdiction of any public utility commission or other commission or regulatory body of the state or states in which the project is located, as to the rates to be charged by such licensee for public service, the licensee shall account for depreciation on the project property in a manner required or authorized by such regulatory authority. If, in the judgment of the commission, such accounting for depreciation does not show that adequate depreciation reserves have been created and are being maintained as to the project property, the licensee shall be subject to and shall comply with any reasonable order of the commission in relation to such accounting for depreciation and to the creation and maintenance of such depreciation reserves. The results attained by accounting for depreciation as required or authorized by such state regulatory body, or by complying with any such reasonable order of the commission, shall be shown in the statements and reports of the licensee to the commission made in accordance with the provisions of the act and of Regulation 20 hereof and shall, in so far as applicable, be binding upon the licensee in the administration of the provisions of the act; and the credit balances shown upon such statements and reports prepared in accordance with such depreciation requirements of such state regulatory body or of such reasonable order of the commission, as provided in this section, shall be deemed to be the "aggregate credit balances of current depreciation accounts" within the meaning of the definition of net investment as set forth in Section 3 of the act, and for any purpose to which such net investment is applicable.

Smith Accepts Illinois Commission Chairmanship

AFTER a long delay the uncertainty as to the head of the Public Utilities Commission of Illinois was settled last week when Col. Frank L. Smith accepted the chairmanship offered him by Governor Small several months ago. No action on the various proposals to abolish or reorganize the commission has yet been taken by the Legislature. The whole utilities commission situation in Illinois stands as it did before Governor Small's election, except that the personnel of the commission is entirely new.

Kansas Public Service Association Arranges Program

THE tentative program for the convention of the Kansas Public Service Association at Kansas City, Mo., on April 20 and 21 includes the following papers: "Public Utilities the People's Business," by Martin J. Insull, president National Electric Light Association; "The Work of the Illinois Committee on Public Utilities Information," by Bernard J. Mullaney of that body; "Selling Our Securities to Our Customers," by C. M. Hamilton of the Electric Bond & Share Company New York, and a paper by C. M. Reed of the Kansas Public Utilities Commission on a subject not yet announced.

As announced previously in the ELECTRICAL WORLD, there will be held in Kansas City during the same week the convention of the Missouri Association of Public Utilities and the first Kansas City electrical show.

Engineering for London Superpower Scheme Approved

THE engineering proposals for a unified power system for London, England, submitted to the conference of local authorities owning central stations have been approved by the conference, according to advices received from the London office of the ELECTRICAL WORLD. It is proposed that the development be divided into two stages. During the first stage under the accepted plan thirty-four stations will be shut down progressively and these stations will be supplied with wholesale power from the remaining plants. At the same time superpower stations will be erected, and as these are completed the second stage will be reached, by which time twenty-six of the remaining generating stations will have been progressively shut down. Of the remaining seventeen plants existing in the area, two would be reconstructed and considerably enlarged to act as superpower plants, while seven would be permanently retained to act as auxiliary plants in conjunction with the superpower plants. The other eight stations, which are near the outskirts of the area, would have to be kept at work for a considerable period to serve the local demands until it became possible to extend the transmission lines there.

Six new superpower plants are to be erected on the Thames River, two on sites now occupied by existing stations and four on new sites. Three of the new sites are to be on the north side of the river and one on the south. The capacity of the new superpower plants will vary between 70,000 kw. and 200,000 kw., mostly in units of 25,000 kw. Several of the sites picked out will permit of much larger stations if they are required.

It is proposed that existing generating stations now used solely for street railways and for railroads continue to supply energy as heretofore to their respective systems, while any railroad not already electrified may obtain energy from the system. All these stations are steam stations, there being no water-power resources in the area.

Committees of the A. I. and S. E. E. for 1921 Are Announced

COMMITTEES of the Association of Iron and Steel Electrical Engineers for 1921 have been announced, with chairmen as follows: Electric furnace, E. T. Moore; standardization, W. T. Snyder; electric development, R. B. Gerhardt; educational, L. F. Galbreath; membership, J. F. Kelly; finance, B. W. Gilson; safety, Walter Greenwood; editing, E. Friedlaender; papers, S. S. Wales; combustion, Frank Leahy; convention, A. H. Swartz.

California Commission Orders 6 per Cent Cut in Southern California's Rates

WHAT amounts to an average cut of 6 per cent in the rates for electrical energy charged by the Southern California Edison Company was ordered last week by the Railroad Commission of California in a decision adjusting the company's schedules. This makes the second cut made in Southern California Edison rates, the commission last January having reduced the surcharge allowed the company from 27 to 20 per cent.

The rates fixed in the new order will constitute the company's definite or base schedules. They are on an average about 28 per cent higher than the rates of pre-war days and are estimated to produce a gross revenue of $15,338,225. This is about 9 per cent less than the amount asked for by the company, but sufficient, in the opinion of the commission, to enable the company to meet its financial needs and also carry out its development program.

The commission estimates that the rates will yield a return of 8.3 per cent on the company's investment, which for rate-fixing purposes the commission finds to be $94,073,656. This sum is several million dollars below the value claimed by the company, whose valuation engineer said it would cost $148,519,624 to reproduce the plant new. Depreciated, the reproduction cost, according to this engineer, would be $128,731,081.

The commission declares that it is inclined to look with favor upon a proposal to divide savings due to economies in operation among the consumers, employees and the company's stockholders and suggests that the company work out and submit a plan. The commission, however, points out that the public utilities act does not contemplate a division of increased profits resulting from changes in conditions and costs not under the control of the company.

Declaring that the economic conditions existing in the territory served by the Edison company are such that the public should not be burdened at this time with any charges in excess of the absolute minimum, the commission frowns upon the company's proposal that it be allowed to create a special reserve of $2,000,000 designed to protect against special unforeseen con-

tingencies. The idea of the company was to create a basic fund to be drawn upon in dry years or to cover possible other contingencies so as to insure continuity of earnings and stability of rates. The commission, while of the opinion that the plan should be followed out, does not believe that this is the time, in view of falling prices and normal weather conditions, to create the reserve through a charge on the consumers.

The effect in general of the new rate schedules will be to reduce the cost of electricity, but in a few cases the schedules will mean an increase owing to the fact that consumers were enjoying favorable rates. A number of special or class rate schedules have been eliminated and certain standard schedules made effective, with the result that all consumers will be placed on the same basis.

Business Men Oppose Taking Licenses from Engineering Corporations

NEW YORK CITY business men are lined up in opposition to a proposed amendment to the state law which would limit the practice of professional engineering to individuals instead of corporations and partnerships as now provided. The Merchants' Association of New York City has gone on record as opposing an amendment which would prohibit the licensing to practice of corporations and partnerships and as approving an amendment which would permit the licensing of both individuals and corporations.

The association says in a published statement: "In the opinion of the Merchants' Association the practice of engineering requires a combination of technical training and experience, of executive capacity and of business judgment matured by experience. Consequently the development of large engineering firms and corporations has been a natural evolution which permits the efficient co-operation of men who can contribute some special technical business or executive talent."

Engineering Foundation Issues Report of Sixth Year's Work

THE Engineering Foundation of the United Engineering Society has issued, through its chairman, Charles F. Rand, its report for the sixth year of its existence, which ended Feb. 10 last. The foundation is a trust fund established by Ambrose Swasey of Cleveland, who in last October added $200,000 to his two previous gifts, making a total endowment of $500,000. Its object is "the furtherance of research in science and in engineering or the advancement in any other manner of the profession of engineering and the good of mankind," and the income is administered by a board composed of members from the four big engineering societies and of members at large.

The most noteworthy undertaking of the foundation for the year under review was an investigation into the fatigue phenomena of metals in charge of Prof. H. F. Moore of the University of Illinois. A statement of the present status of this investigation is contained in the report. The General Electric Company has contributed $30,000 to it in order to include special problems connected with nickel steel. Other accomplishments of the past year were the reorganization of the division of engineering along lines corresponding to the broad fields of engineering activity, with a large advisory committee for each broad field, sponsored by an appropriate leading engineering society; the organization of a bureau of welding and establishment of ten working committees on subjects of practical importance to this new industry; organization of an advisory board on highway research to assist existing bodies by co-ordinating their research activities into a national program; progress in research by the committee on heat treatment of carbon steel; organization of a large committee on electrical insulation.

Southern Operating Engineers Form New Association

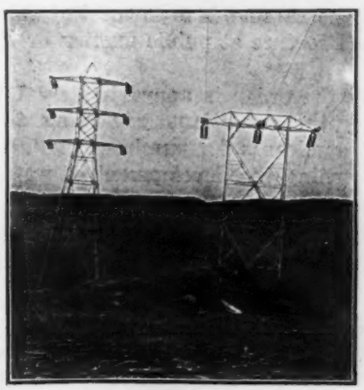
SOUTHERN electric light and power plant engineers and operators have formed a new organization known as the American Association of Operating Engineers, the aims and objects of which are to promote a better understanding between the operating men and maintenance men, as well as to provide a clearing house for their many problems. Labor problems will not be discussed by the new body. A geographical section meeting will be held three times a year. The association concluded on April 7 a three days' meeting at Atlanta at which about fifty were in attendance. The next meeting will be held early in October in Birmingham.

Representatives of the following power companies were present at the convention: Georgia Railway & Power Company, Tennessee Power Company, Alabama Power Company, Central Georgia Power Company, Columbus Power Company, Aluminum Company of America and the Kentucky Public Utilities Company.

At the closing sessions the following officers were elected: President, H. L. Wills, engineer and operating manager of the Georgia Railway & Power Company; vice-president, J. M. Oliver, Alabama Power Company; secretary, H. C. Bristol, Tallassee Power Company; treasurer; W. F. Bellinger, Georgia Railway & Power Company; members of executive committee, G. S. Nunemaker, Tennessee Power Company, and G. A. Iler, Georgia Railway & Power Company.

No formal papers were prepared for the meeting, most of the time being taken up in discussions of vital power-plant problems now confronting the operators. On Wednesday, April 6, the delegates saw the changing of the insulators on a live line on the Atlanta system. These lines come in from Tallulah Falls under a pressure of 110,000 volts. A demonstration also was given of the Bennett lightning arrester. At the conclusion of the meeting the delegates were the guests of the Georgia Railway & Power Company at its Morgan Falls plant.

New 165,000-Volt Line



On the right is pictured a tower on the new 186-mile 165,000-volt line to the new 40,000-kw. Caribou hydro-electric plant of the Great Western Power Company of California. The receiving substation is near San Francisco. The line on the left is 154 miles long, operating on 110,000 volts to the Las Plumas water-power plant of the same company.

Wireless to Aid Load Dispatching of Southern Interconnection

THE installation of two wireless stations for the purpose of intercommunication between different companies interconnected with the system is proposed by the Georgia Railway & Power Company in its load-dispatching arrangements. A government license has been obtained. The other companies forming the interconnection are also installing wireless equipments.

It is further proposed to enable the load-dispatcher's office to work in connection with high-powered stations and supervise the operation of repair and trouble crews on high-voltage line maintenance. The company expects to effect a large saving through the more efficient directing of the crews in their movements from place to place at times when interruptions occur due to the breakdown of the transmission line or structure, and it is thought that this will aid materially in shortening the time of interruptions.

Presentation of Insulating-Material Specifications Expected

AT THE 1921 annual meeting of the American Society for Testing Materials, to be held at the New Monterey Hotel, Asbury Park, N. J., June 20 to 24 inclusive, data on electrical insulating materials will, it is expected, be presented.

It is hoped to complete committee work which will permit the presentation of new tests for insulating varnishes, transformer oils and porcelain. A large amount of work has been done during the current year, it is stated, on all of these items, particularly transformer oils. In connection with the latter results of experimental work done during the last three or four years by four different laboratories have been analyzed and the conclusions utilized in the preparation of the specifications. It is expected that these data will be included in the committee's report.

A new specification for rubber gloves for electrical workers is to be proposed this year. A specification for rubber insulating tape is also under discussion.

Manitoba Water Powers and the Canadian Pulp-Wood Industry

WITH a view to meeting as quickly as possible the demand for newsprint in the provinces of Manitoba, Alberta and Saskatchewan, the United States Vice-Consul at Montreal reports, an order in council issued at Ottawa on Feb. 14 authorized the Canadian Minister of the Interior to dispose of timber rights for the manufacture of pulp wood on certain lands to the east of Lake Winnipeg in Manitoba Province at public auction or by tender.

The area covered by the order is approximately 718 square miles. Among the conditions governing the issuance of permits to applicants for purchase rights is the following one concerning the development of water power:

> That the purchaser may, if he so desires, apply under the Dominion water-power regulations for the right to develop any conveniently located water power for the purpose of supplying energy to his mill or mills; and if the water power applied for is available and is, in the opinion of the Minister, the most suitable source of power for the purpose, and provided its use therefor will not conflict with the public interest, the Minister shall proceed under the water-power regulations to enter into an agreement with the purchaser whereby the purchaser shall, on the satisfactory completion of the development, become entitled to a lease of the necessary Dominion lands and a license to use the water for the purpose of his water-power development.

Uniform Coal Contract Proposed by Fuel Committee of Purchasing Agents

THE fuel committee of the National Association of Purchasing Agents, which has for some time been engaged in formulating recommendations for reasonably uniform provisions in coal contracts, has drawn up a form which it believes can be advantageously used in most commercial contracts for the purchase of coal, special clauses being added to the contract where conditions make this necessary. The form has been prepared simply as a convenience to the members of the National Association of Purchasing Agents and the trade and is submitted by the committee for the use of those whose requirements it will meet. It has been carefully worked out to cover all general conditions and is particularly designed to prevent misunderstandings between buyer and seller such as arose from loosely drawn agreements in effect last year.

Inclosure of Fuses and Switches Growing in Favor

THE inclosed switch and fuse situation was the subject of discussion at a meeting of the Western New England Association of Electrical Inspectors in Springfield, Mass., March 30, to which A. T. Wheeler, vice-president Trumbull Electric Manufacturing Company; Dr. M. G. Lloyd, assistant physicist Bureau of Standards, and B. H. Glover, associate electrical engineer Underwriters' Laboratories, Chicago, contributed. The discussion emphasized the transmission stage of the art and indicated the trend of future developments. Mr. Wheeler pointed out that the Underwriters have not assembled under one head a set of rules governing the manufacture or installation of inclosed switches and fuses, but the time appears not far distant when there will be recommended published rules covering these points, becoming imperative in a few years, and such rules will probably become mandatory in many states and municipalities even earlier. Many safety rules are at present in vogue, some of which deal with entrance devices.

If these continue to exhibit lack of uniformity, there will be confusion, and a considerable increase in investment by manufacturers in equipment and stocks will be required. Five different types of inclosed switches have become recognized in existing rules, embodying different degrees of protection as follows:

1. The ordinary fused or unfused knife switch, inclosed in a case which had to be opened to operate the switch. This affords no protection to the operator and is dangerous. It, however, prevents accidental contact with live parts when the cover is closed and locked.

2. The knife switch externally operated by a handle outside, but in which the live parts can be exposed by opening the cover with the switch closed. This has some degree of protection if the cover is kept locked.

3. The type of fused switch with cover that can only be opened when the switch is open. Switch can be closed only

after cover is closed. This affords still greater protection, especially if live incoming contacts are not readily acessible.

4. The type of fused switch having a separate compartment for fuses, the compartment being accessible only when the switch is open. The switch parts are in another compartment and are not accessible. This construction is more nearly foolproof than the others. There is still a hazard in that the switch may be wrongly wired, and it is possible to remove and not replace parts of the switch covering.

5. The foolproof types that cannot be wrongly wired and which prevent access to any live part under nearly all conditions that may arise during use. This type will in time be developed, but its cost may militate against its employment for some time. It must be capable of having its component parts in such shape that no part can be permanently removed without the switch ceasing to function.

Panel boards have kept pace with the requirements also. Within the last few months a proposed set of rules governing specified tests and providing installation requirements have been prepared by three national qualified bodies in co-operation.

Dr. Lloyd pointed out that there has been considerable sentiment among the members of the electrical committee of the National Fire Protection Association for making more stringent requirements as to switch and fuse inclosure, but that there still exists considerable difference of opinion as to how far these restrictions should go. At the last revision of the code it was decided to make a beginning at the service entrance and the rules now require the inclosing of service fuses and switches unless mounted on switchboards under competent supervision. It is also requisite now to install the switch ahead of the fuse so that the latter may be "killed" before handling.

Mr. Glover stated that many questions remain to be answered as to the inclosure of all switches regardless of voltage and current-carrying capacity, the limitations on the loading of manually operated switches, comparative safety of switch operators and the general public proportions of inclosing spaces and character of material best adapted to protective duties.

Program for American Welding Society Convention, April 27-30

THE annual meeting of the American Welding Society will be held at the Engineering Societies Building, New York, April 27 to 30. The program for the convention is as follows:

WEDNESDAY, APRIL 27

Morning—Gas welding committee; resistance welding committee.

Afternoon—Welding wire specifications committee; welding conference committee.

THURSDAY, APRIL 28

Morning—Board of directors; committee on specifications for steel to be welded.

Afternoon—Business session.

Evening—Technical session. "Applications of the Automatic Welding Machine," by P. O. Noble; "Production Welding with the Gas Flame"; "Results of Recent Thermit Welding Research," by J. H. Deppeler.

FRIDAY, APRIL 29

Morning—Board of directors; electric arc welding committee.

Afternoon—American Bureau of Welding.

SATURDAY, APRIL 30

Morning—Committee on welding of storage tanks; committee on training of operators.

Electric Light and Power Business Picking Up

SPRING business with the electric light and power companies is picking up. Evidence of this is had in the February report of the subsidiaries of the Standard Gas & Electric Company, which are widely scattered over the country.

During February contracts were secured for 5,285 new services with 2,938 kw. of lighting and 4,620 hp. in motors, a material increase over new business secured in January, 1921, and February, 1920. The net gain in connected load for the month included 1,815 customers, with 1,139 kw. of lighting and 2,770 hp. in motors. The electrical energy output for the month was 65,130,374 kw.-hr., an increase of only 1.4 per cent over February, 1920, due to the temporary idleness of industries in certain territories served. This condition is only temporary, it is stated, and there should be a decided improvement in the rate of increase of electrical energy output in the next few months.

Two new transmission lines were completed during the month by the Northern States Power Company, one to serve the Home Light & Power Company at Jasper, Minn., and one to serve the town of Brownton, where a municipally owned generating plant has been abandoned. Both of these lines were completed in the southwestern division of the territory of the Northern States Power Company, by which company the electric service will be supplied.

Two new "white-way" lighting systems have been completed, one to serve 120 standards on the main streets of Enid, Okla., and one to serve forty-six standards on First Street, Oklahoma City.

A large contract for electric ranges was secured in February at St. Paul, covering 156 5-kw. electric ranges for new apartment buildings which one contractor is arranging to complete this spring and summer.

The Minneapolis General Electric Company reports February sales of $23,000 of electric household appliances and an increase of 17 per cent in house-wiring business over February, 1920; also an increase of 100 per cent in new business connected.

Transformer Transportation

Ten horsepower to haul a 4,167-kva., single-phase transformer up to the Duquesne Light Company's new north substation which is to form part of the power loop for the Pittsburgh District.

British Columbia Farmers Want Province to Own Water Powers.—A resolution has been passed by the United Farmers' Association of British Columbia asking the provincial government to create a commission on the model of the Hydro-Electric Power Commission of Ontario "for the purpose of developing and operating as government-owned public utilities the water powers of British Columbia."

To Electrify French Canals.—It is proposed to electrify all French canals which carry more than 2,000,000 tons of traffic per annum. Sections of various canals already electrified show that this program will mean a saving of about 1,500,000 tons of coal per annum. In 1920 French canals handled 96,518,681 tons of merchandise, as against 52,428,400 tons handled in 1919. During the war 645 miles of French canals were destroyed. Since the armistice 632 miles have been wholly reconstructed. Out of 1,120 locks, culverts, etc., destroyed, 890 have been rebuilt.

Longest Overland Radio Route.—After three months' interruption of operations owing to the Russian incursion into Mongolia, the wireless station at Urga, in that province, is now able to communicate with Peking. This marks the successful completion of the first span of the longest overland wireless telegraph route in the world, says the *Wireless Age*. The Marconi company is under contract to construct stations at Urunchi (in the Chinese province of Sungaria, Central Asia) and Kashgar (in eastern Turkestan), for which construction parties are being organized.

American Specification Institute Founded.—"To improve the conditions affecting the writing of specifications and to benefit by organized effort," the American Specification Institute has been founded at Chicago, with offices at 127 North Dearborn Street. It purposes to increase knowledge concerning specifications and improve the methods of writing them, including those for buildings and engineering structures. The development of specification writers who will have professional recognition is one aim. These will be the active members of the institute, their employers to be associate members, and engineers and instructors honorary members. Gardner C. Coughlin is secretary pro tem.

Heating of Underground Cables.—The British Electrical and Allied Industries Research Association has recently, says the London *Engineer*, presented to the Institution of Electrical Engineers a report on the heating of buried cables. The greater part of the investigation was carried on at the National Physical Laboratory, where twenty-seven cables were tested under various typical conditions. It was found that the increased carrying capacity of an underground cable is greater with low-tension than with high-tension conductors owing to the thinner dielectric of the former. Further, the rate of temperature rise of a cable in ducts is more rapid than when laid solid or direct in the ground, from which it follows that for intermittent loading a cable laid in the ground will be better able to carry peak loads than one laid in ducts.

Current News and Notes

Timely items on electrical happenings throughout the world, together with brief notes of general interest.

"Board of Trade Unit" Dies.—In Great Britain the kilowatt-hour has been officially known as the "Board of Trade unit." Among the "minor tragedies" of the transfer of the control of electricity supply from the Board of Trade to the Ministry of Transport, says the *Electrician* of London, is the disappearance of this term, though "its demise has hardly been noticed, much less regretted." Efforts to bring the use of "kelvin" into popularity, the *Electrician* says, have not met with success. Apparently British usage will gradually conform to that of the United States and other nations where "kilowatt-hour" is the universally accepted term.

Growth of Nebraska Power Company.—A recent hearing before the City Council of Omaha of an application made by the Nebraska Power Company for increased electrical rates brought out the following figures showing the company's growth since its organization in 1917 to succeed the Omaha Electric Light & Power Company, sales for lighting and power in 1916 having been 48,903,160 kw.-hr.: 1917, 57,645,394 kw.-hr.; 1918, 63,646,270 kw.-hr.; 1919, 82,740,920 kw.-hr.; 1920, 96,604,047 kw.-hr. The company's net revenues during this period showed, according to the findings of the City Council, an increase from $684,463 to $938,337, excluding expenditures incurred in preparing for the investigation.

New Orleans' Big Dock Fire Was Not Caused by Electricity.—When a ten-million-dollar waterfront fire occurred in New Orleans last January picture supplements published by newspapers in Chicago and elsewhere carried photographs of the burning wharves bearing a legend to the effect that "short-circuiting of an electric wire near the surface of water that was covered with oil is believed to have caused this conflagration." The National Electric Light Association challenged this statement and drew from the chief engineer of the National Board of Underwriters the following letter: "The recent fire at the Jahncke dry dock was not caused by the breakage of an electric wire, as reported in the newspapers. An investigation by one of our engineers indicates that a hot rivet dropped from a ship undergoing repairs into oil-coated débris on the water surface was the probable cause. As a matter of fact there were no electric wires anywhere near the scene of this fire the breakage of which could possibly have ignited the oil on the water surface. A 400-volt line was in course of installation and the conduit for this line was attached to the under side of the pier flooring, but wires had not been drawn. The wires for lighting purposes are located on the land at such a distance back from the dock front as to preclude the possibility of any broken wires falling into the water."

"Hydro Municipalities" in Ontario.—In a recent *Bulletin* of the Hydro-Electric Power Commission of Ontario the "hydro municipalities" of the province are listed as follows: Niagara system, 143 municipalities, with a total of 1,122,472 hp.; Severn system, 19 municipalities, 42,906 hp.; Wasdell's system, 11 municipalities, 11,711 hp.; Nipissing system, 4 municipalities, 10,682 hp.; Muskoka system, 2 municipalities, 10,682 hp.; Eugenia system, 28 municipalities, 33,236 hp.; Ottawa system, 1 municipality, 104,067 hp.; Thunder Bay system, 1 municipality, 15,100 hp.; Central Ontario system, 37 municipalities, 118,617 hp.; St. Lawrence system, 11 municipalities, 16,470 hp.; Rideau system, 5 municipalities, 13,745 hp.; Essex County system, 7 municipalities, 10,615 hp.; Thorold system, 1 municipality, 4,325 hp. The Niagara, Thorold and Essex County systems are operated at 25 cycles, all the others at 60 cycles.

Vacuum-Tube Amplifier Used to Study Heart Beats.—A demonstration was recently given in Washington to medical men of a device developed in the Signal Corps laboratory whereby heart beats may be amplified thousands of times and made audible over long distances. The principle involved is similar to the one used in the large amplifier employed to increase the volume of the President's inaugural address. A special "heart transmitter" rests by its own weight over the patient's heart. The passage of the blood through the different valves of the heart causes vibrations in an air chamber which faithfully reproduces all of the various actions of the blood passing through the different valves of the heart. These are transmitted over the wire to an amplifying apparatus which consists of a group of standard Signal Corps vacuum tubes such as are used in wireless telephony and telegraphy, and a special receiver attached to a large horn projects the sounds. The patient may be in the middle of the Atlantic, the experts say, the difficulty of transmitting such delicate sounds being overcome by using a high-frequency carrier wave or line radio for transmitting the heart beats over the ordinary wire circuits from the receiving station. This carrier wave is in fact an electric wave of a frequency above the human ear, and such waves are guided by the telephone wire to the receiving amplifier. The carrier waves are modulated by the heart-beat variations and demodulated and amplified at the receiving apparatus.

Recent Court Decisions

Findings of higher courts in legal cases involving electric light, power and other public utility companies

Hearing Before Commission Must Precede Order to Public Utility to Increase Rates.—The Supreme Court of North Dakota has held, in City Commission of Bismarck vs. Bismarck Water Supply Company, that under the public utilities law of the state the Board of Railroad Commissioners can grant an increase in rates to a public service company only after a hearing has been held. The increase in dispute, having been made without notice and hearing, was void. (181 N. W. 596.)*

Operating Expenses Held to Include Federal Income Tax.—In determining in favor of the plaintiff a suit brought by the Municipal Gas Company of Albany against the Public Service Commission of New York, Second District, in which the company claimed that the statutory rate enforcement of which was sought by the commission, was confiscatory, the New York Supreme Court held that the federal income tax levied against the company was rightly included in operating expenses, the tax being payable by the corporation and not assessed against the income of the individual stockholders. (186 N. Y. S. 541.)

Public Utilities Act of North Dakota Held Not to Affect Franchise Rates.—In an action brought by the Western Electric Company (North Dakota) against the city of Jamestown, the Supreme Court of North Dakota held that where, pursuant to a contract for one year, made in 1912, the company had furnished electrical energy from year to year and had accepted payment at the rate named in such contract, this contract was continued and renewed by practical construction, notwithstanding that in 1914 the City Council adopted a resolution canceling the contract and notwithstanding also that in February, 1918, the corporation gave notice of a surcharge of 10 per cent without the city's having agreed to pay this increased rate. The public utilities act, the court held also, did not abrogate or affect the terms of a pumping contract adopted in 1902. Nor was the city obligated to pay for electrical energy furnished to a public reading room in the city hall for which no specific request had been made by the city and no bill rendered by the company for the years from 1910 to 1914 and which it continued to supply up to the beginning of the action with knowledge that the city claimed this service was obligatory under the franchise. (181 N. W. 363.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Franchise Rate Must Not Be Changed Merely on Ground of Unprofitableness.—Although upholding an injunction obtained by the village of Warsaw to restrain the Pavilion Natural Gas Company from raising its rates (see issue of Dec. 25, 1920, page 1282) the Appellate Division of the New York State Supreme Court has found that the state in the exercise of its reserve police power has a right to modify a rate fixed in the franchise of a public service corporation in the public interest, if it be deemed unjust or unreasonable. The exercise of this power by the state does not violate the constitutional provision against impairing the obligation of contracts, the court holds, and public service contracts usually are made with the regulatory power of the state in mind. The state cannot modify a franchise rate on the mere ground that it is unprofitable, however.

Wisconsin Constitutional Provision Wrongly Applied to Contract with Electric Company. — A constitutional provision of Wisconsin requiring a municipal corporation incurring any indebtedness to provide for the collection of a direct annual tax sufficient to pay interest as it falls due and to pay the principal within twenty years has been held by the Wisconsin Supreme Court in Milwaukee Electric Railway & Light Company vs. City of Milwaukee, to be inapplicable to a city contract which requires the company to operate a park electric lighting system, terminable after two years by the city's acquisition of title to the plant, upon payment to the company of the difference between the special investment in the park lighting system and the accumulated depreciation reserve provided for at the date of termination, there being an absence of proof that the depreciation reserve exceeded its legitimate limits and that the charge therefor was so excessive as to constitute a payment upon capital. A charge for depreciation is a necessary and proper element of the cost of each year's service and is in the nature of an expense of operation, and provision should be made therefor out of earnings. (181 N. W. 298.)

Associations and Societies

A complete Directory of Electrical Associations is printed in the first issue of each month.

Engineering Society of Akron.—At the meeting of the Engineering Society of Akron, Ohio, on Tuesday last, April 12, E. P. Roberts spoke on "Valuation of Public Service Properties for the Purpose of Rate Making."

Pacific Coast N. E. L. A. Convention Postponed.—The annual convention of the Pacific Coast Division of the N. E. L. A., originally scheduled for May 25, 26 and 27 at Del Monte, Cal., has been postponed to June 7, 8 and 9.

Institute Meetings.—Two sections of the A. I. E. E. were scheduled to meet last night (April 15). The Baltimore Section was to hear Dr. C. P. Steinmetz on the relation of the electric motor car to the industry, and the Schenectady Section was to listen to a discussion of illumination by W. D'A. Ryan. Next week three section meetings are announced. At Cleveland on April 19 L. D. Bale will discuss "The Automatic Railway Substation"; at New York on April 22 Prof. Comfort A. Adams will have charge of a discussion on engineering education held jointly with the A. S. M. E., and the annual business meeting will take place; at Chicago on April 25 there will be a joint meeting with the electrical and mining sections of the Western Society of Engineers and the A. I. and S. E. E., when Carl Lee will speak on the diversity factor of coal-mining loads and W. C. Adams on power distribution systems for coal mines. "Toll-Line Practice" will be the subject of J. E. Heller, of the Pacific Telephone & Telegraph Company, before the San Francisco Section on April 29, and "Electric Power in Pulp and Paper Mills" that of T. H. Crosby before the Vancouver (B. C.) Section on May 6.

Coming Meetings of Electrical and Other Technical Societies

A. I. and S. E. E. Section Meetings—Pittsburg, April 16; Chicago, April 25; Philadelphia May 7; Cleveland, May 9.

A. I. E. E. Section Meetings—Pittsburgh (joint session with A. I. and S. E. E.; for program see issue of March 19, page 672), April 16; Cleveland, April 19; New York (joint session with A. S. M. E.), April 22; Chicago, April 25; San Francisco, April 29; Vancouver B. C. May 6

American Welding Society — Metropolitan Section, New York, April 19.

Kansas Public Service Association—Kansas City, Mo., April 20-21.

Missouri Association of Public Utilities—Kansas City April 21-23.

American Electrochemical Society—Atlantic City, April 21-23.

American Physical Society—Washington, April 23.

United States Chamber of Commerce — Atlantic City, April 27-29.

American Society of Civil Engineers—Houston Tex., April 27.

American Association of Engineers—Buffalo, May 9-11

N. E. L. A., Southwestern Geographic Division—Hot Springs Ark., May 13-14.

American Washing Machine Manufacturers' Association—Chicago, May 18-19.

Southwestern Electrical and Gas Association—Galveston, Tex., May 18-21.

National Electric Credit Association—Richmond Va., May 19-20.

A. I. E. E., Annual Meeting—New York, May 20

American Society of Mechanical Engineers —Chicago, May 23-26.

Electrical Supply Jobbers' Association—Hot Springs, Va., May 25-27.

N. E. L. A. Annual Convention—Chicago May 31-June 3

N. E. L. A., Pacific Coast Section — Del Monte, Cal., June 7-9. (For program see issue of Jan. 29, page 278.)

Sliding Scale for Lighting Rates Sustained Where Already in Force.—While asserting that ordinarily a sliding scale for electricity or gas dependent upon the price of coal or other commodity should not be fixed for lighting rates and that a decision permitting such a scale should not be considered a precedent for the future, the New York State Public Service Commission, Second District, permitted the Iroquois Utilities, Inc., to extend such a charge to the village of Randolph, despite the protest of the village trustees, on the ground that to do otherwise would constitute discrimination inasmuch as the rate was already in force in the rest of the territory served by the company and had aroused no complaint. A readjustment for the entire territory, the commission held, should be postponed until the rapid variations in the price of coal shall have ceased.

Gas and Electric Departments of Lighting Company Must Be Kept Separate.—The city of Kingston, N. Y., having suggested during the hearing of an application by the Kingston Gas & Electric Company for increased gas rates that the business of both the electric and gas departments of the petitioner should be taken into consideration, the New York Public Service Commission for the Second District declared, "This is not the law," quoting a court decision to the effect that in fixing the price of electricity the plaintiff is not entitled to recoup its losses upon sales of gas. For the same reason, in fixing the price of gas it is not required to make allowance for a just and reasonable profit which is the limit of permissible return upon its rates for electricity. The commission asserted its belief that a service charge, which it said was more correctly designated as a ready-to-serve charge, is a proper charge.

Voltage Variation — Inductive Interference.—An investigation of the adequacy of the service rendered by the Badger Public Service Company and of inductive interference between its lines and those of telephone companies has been made by the Wisconsin Railroad Commission, which declared the service inadequate and the voltage variation beyond the limit set by the commission. The commission held that the patrons of the company were entitled to prompt relief from the extreme voltage variation and required the company to make certain specified changes in the lines. It found that the transmission lines of the company had in several cases been constructed without due regard to the prevention of inductive interference and in violation of the commission's order covering standards for the safe construction and operation of electric systems. The company was ordered to transfer the wires of the Big Six Telephone Company to the poles of the Eastern Wisconsin Telephone Company and pay to the Eastern Wisconsin Telephone Company $1.45 per pole to prepay pole rental at 7½ cents per contact per year. In case this rental is not acceptable to the Eastern Wisconsin Telephone Company, the transfer was ordered made and the matter brought before the commission for determination.

Commission Rulings

Important decisions of various state bodies involving or affecting electric light and power utilities

Sinking-Fund Payments Are Not Operating Expenses.—Payments into a sinking fund for the redemption of bonds form no part of the operating expenses of a utility, the Indiana Public Service Commission took occasion to declare in passing upon a petition for approval of reduction of stock, but must be paid out of gross income, since otherwise the ratepayer would buy the corpus of the property itself and turn it over to the stockholders.

Twenty per Cent Lighting Penalty Exorbitant.—The Public Service Commission of Pennsylvania has handed down a decision in a case against the Newmanstown Electric Light & Power Company to the effect that a 20 per cent penalty for failure to pay bills for electric service in ten days, as provided by the rules of the company, is "both unreasonable and exorbitant and is out of line with the usual and ordinary penalty imposed by utilities for that purpose." In ordering the company to amend its rules in this respect, the commission says: "There is no occasion to impose an exorbitant penalty to enforce prompt payment of a bill, since a public utility has within its power the right to discontinue the service for non-payment of bills."

Responsibility for Inadequate Service.—In sustaining a complaint of inadequate service against the St. Clair County Gas & Electric Company the Illinois Public Utilities Commission made these observations: (1) Public utilities enjoying a monopoly and the benefit of protection from competition must, notwithstanding the difficulty of obtaining capital under abnormal economic conditions, find some means of procuring such funds as may reasonably be required to make necessary extensions and improvements. (2) If the commission's standards of service are to be lowered, rates commensurate with the lower grade of service should reasonably be expected. (3) The war being over, the burden of providing the necessary capital for making extensions is one that should be assumed by the utilities. Finding that a producing company, the East St. Louis Light & Power Company, was partly responsible for the inadequate service of the St. Clair County company, to which it supplied electrical energy, the commission ordered that it be made a party to the proceeding.

Compensation to City in Return for Cancellation of Franchise Disapproved as Discrimination Against Outside Customers.—The Idaho Public Utilities Commission, which in authorizing the cancellation of franchises granted by Boise to the Idaho Power Company ordered the company to raise its rates within that city to offset payments to be made to the city by the company for annulling the franchise, has refused to rescind its order at the instance of the city authorities, who claim that by this decision the company and its outside customers will receive the value of franchise rights which are the property of the city. The commission holds that these so-called rights are themselves advantages and preferences and that to permit conpensation for their surrender would give the city an unfair advantage over other localities. "Whether the privilege of the franchise is of sufficient value to the city to justify the cost is not for us to say," the commission concludes. "That is for the city to determine. Our province and duty go no further than to see that the cost of these benefits does not fall on those who receive no benefit from them; that is, to see that the rates paid by those who receive the benefits reflect all the cost of those benefits, and if the franchise were to remain in force, there would be required such rate change in the city as would lift the burden of its cost from the customers outside of the city."

Inductive Interference and Assessment of Cost of Remedial Measures.—An application from the Nebraska Power Company and Platte Valley Power Company for permission to construct a 13,200-volt electric transmission line between substations in Omaha and along a route where on certain streets both sides of the road were occupied by lines belonging to telegraph and telephone companies was denied by the Nebraska Street Railway Commission, which pointed out the possibility of the power company's using an alternate route. The commission, however, did not assent to the contention of the telephone company that if an order were issued requiring a transposition of some of the existing wires from the side of the street where they now are to the opposite side in order to permit the power company to run its line without giving rise to inductive interference, then all the costs should be assessed against the power company. "Very probably," it said, "the telephone company would find itself with properties of longer life under the removal than before. It might also have certain salvage in the old line. In so far as more expensive pole-line construction is by the telephone company found necessary, such added telephone construction would enhance the value of the telephone company's properties, and such expense ought not to be borne by the power company. Nothing in law would indicate that an existing public utility on a highway is immune to expense made necessary by an additional use of the highway in the public interest."

Men of the Industry

Changes in Personnel—Responsibilities and Association Appointments of Men Engaged in Professional, Executive, Operating and Commercial Branches of the Industry

Shiras Morris, who since 1914 has been president and treasurer of the Hart & Hegeman Manufacturing Company, Hartford, Conn., was elected president of the Associated Manufacturers of Electrical Supplies at its recent meeting. Mr. Morris has also been elected treasurer of the Electrical Manufacturers' Council, to succeed the late E. B. Hatch. Besides his connection with the electrical industry, Mr. Morris is identified with several industrial companies and banking institutions. He is vice-president of the Hartford branch of the National Metal Trades Association, a member of the directorates of the Bush Manufacturing Company of Hartford, the Dime Savings Bank of Hartford, the Hartford Morris Plan Bank, the State Bank & Trust Company and the Terry Steam Turbine Company of Hartford. He is also a member of the board of trustees of Choate School, Wallingford, Conn., and of Trinity College, Hartford; a member of the Hartford Club, University Club, Hartford Golf Club, the Country Club of Farmington Republican Club and other social organizations. Mr. Morris was graduated from Trinity College, Hartford, in 1896 and for a short time was connected with the Pope Manufacturing Company. He very soon joined the Hart & Hegeman Manufacturing Company, and two years afterward was chosen secretary, later assuming the additional duties of treasurer.

SHIRAS MORRIS

H. W. Butler of the engineering staff of the Superpower Survey has gone to Washington to assist Harold Goodwin in the compiling of electrical data from the returns to the Bureau of the Census.

G. H. Canfield of the staff of the United States Geological Survey has been detailed to make investigations of water-power sites in Alaska for the Federal Power Commission.

Alexander C. Barker has been placed in charge of the Montreal office of Dwight P. Robinson & Company, Inc., engineers and constructors of New York, with the title of vice-president. This company has done extensive construction and engineering work in Canada for the Canadian Pacific Railway, Canadian Salt Company, Canadian Crocker-Wheeler Company and the Grand Trunk Railway.

H. C. Ross, who has been appointed manager of the Fresno (Cal.) division of the Pacific Gas & Electric Company, has been connected with various public utilities since 1900. He was born in Baltimore in 1882 and lived there until 1910. In 1900 he entered into the employ of the Consolidated Gas & Electric Light Company of Baltimore, where he worked up through various positions to that of superintendent of shops. From 1910 to 1914 he was superintendent of shops and agent of the Manufacturers' Light & Heat Company of Pittsburgh. He was industrial engineer of the Southern California Gas Company from 1914 to 1915, when his employment by the Pacific Gas & Electric Company as new-business manager at Fresno began. From 1916 to 1919 he was in the San Francisco office of that company as sales supervisor; then he returned to Fresno as district manager, later being promoted to division manager.

H. C. ROSS

C. S. Northcutt has recently been appointed manager of the San Joaquin (Cal.) division of the Pacific Gas & Electric Company, which comprises four districts, Stanislaus, San Joaquin, Tuolumne and Electra, covering five counties in east central California. Mr. Northcutt is a native of Georgia, where he was born in 1885 and where he had a varied commercial and banking training until he went to California in 1905. Until 1909 he was employed by the United Railroads of San Francisco and later by the Union Construction Company, then engaged in building hydroelectric projects. Upon completion of construction work Mr. Northcutt was transferred to the executive offices of the Sierra & San Francisco Power Company. In 1910 he was appointed agent in Modesto, and in 1911 he was promoted to the position of manager of the Modesto district. When, in January, 1920, the Sierra & San Francisco Power Company was leased by the Pacific Gas & Electric Company Mr. Northcutt was made manager of the Stanislaus district. In January, 1921, he was brought back to Modesto and his present position.

C. S. NORTHCUTT

B. A. Behrend, whose photograph appears on page 864 of this issue, with comments on his achievements as an engineer-scientist, was born in Switzerland May 9, 1875, and was educated in England and France and at the university and Polytechnic Institute in Berlin. Upon returning to Switzerland he became assistant engineer of the Oerlikon company. In the '90s he came to this country and became identified with the Bullock Electric Manufacturing Company as chief engineer. Mr. Behrend's achievements have won for him the gold medal of the Louisiana Purchase Exposition at St. Louis, in 1904 and the John Scott medal of the Franklin Institute in 1911. He is author of "The Induction Motor, Its Theory and Design" (1900 in English, 1902 in French, 1903 in German); "The Debt of Electrical Engineering to C. E. L. Brown," 1901; "Engineering Education," 1907, and many papers on the

theory of alternating-current motors and generators. He is a fellow and past vice-president of the A. I. E. E., a fellow of the American Academy of Arts and Sciences and a member of the American Association for the Advancement of Science, the A. S. M. E. and the A. S. C. E.

Dr. Alexander Graham Bell, who during the past winter spent some time abroad, has recently returned to Nova Scotia, where his Cape Breton laboratory is located. Here Dr. Bell built his famous 70-mile-an-hour hydroplane. He is now actively engaged in special work in this laboratory. Dr. Bell celebrated his seventy-third birthday on March 4.

H. A. Strickland has been appointed sales representative for the State of Michigan for the Maring Wire Company, Muskegon, manufacturer of

H. A. STRICKLAND

enameled and cotton-covered magnet wire, with headquarters at 844 Book Building, Detroit.

Joseph T. Blondin, director of the *Revue Générale de l'Electricité,* the leading electrical journal of France, has been nominated by the French government to be a chevalier of the Legion of Honor. Mr. Blondin, who was born at Dieppe on March 19, 1863, was educated at Paris, showing special aptitude for scientific studies, and became professor of physics at the lyceum of Pointe-à-Pitre, Guadeloupe, and subsequently at lyceums in Cahors and Orléans, in France, and finally, in 1895, at the Rollin lyceum, where he still remains. He engaged in publishing technical works in 1886, in addition to his professional duties, and, beginning in 1889, he contributed to various journals, particularly *La Lumière Electrique,* of which he was long the chief scientific editor, many original articles upon mathematical physics, notable among them being the expounding of a vortical theory of electricity inspired by Henri Poincaré's work on vortexes. Mr. Blondin was the director of *L'Eclairage Electrique* from 1894 to 1904 and the *Revue Electrique* from 1904 to 1917, and when the *Revue Générale de l'Electricité* was founded in the year last named he was made director of it.

H. M. Addinsell, who for the past fifteen years has been intimately associated with the problems of public utility financing and is well known in utility banking circles, has been appointed chairman of the public utilities committee of the Investment Bankers' Association. Mr. Addinsell has been associated with Harris, Forbes & Company since December, 1905, except for a period of a year and a half when he served as captain of field artillery in the United States Army. He spent half of that time in France. Previous to his present connection he was for two years in the business department of the New York *Times.* Mr. Addinsell is a director of Harris, Forbes & Company.

Herbert J. Mayo will represent the Benjamin Electric & Manufacturing Company, Chicago, in its San Francisco office, which will be opened very shortly.

H. W. Kilkenny, for many years connected with the General Electric Company, has become associated with the Tubular Woven Fabric Company, Pawtucket, R. I., in charge of its Cleveland office.

Howard W. Maxham, formerly superintendent of automotive transportation for the American Bosch Magneto Corporation, Springfield, Mass., has resigned to take charge of the maintenance department of Gray & Davis, Inc., at Amesbury, Mass.

L. C. Williams, formerly insulator specialist for the Westinghouse Electric & Manufacturing Company of San Francisco, Cal., has resigned to engage in private business. Mr. Williams was at one time connected with the Pacific Gas & Electric Company, San Francisco, in that company's transmission department.

W. W. Joy has joined the forces of the Advance Machinery & Supply Company, Denver, Col., as vice-president and sales manager. Mr. Joy, who is a graduate of Ames College, Iowa, and a member of the A. S. M. E., for the past three years, has been special sales promotion representative for the Fisher-Governor Company, Marshalltown, Iowa. The Advance Machinery & Supply Company is the sales representative for twenty-three manufacturers of steam and electrical specialties.

Ezra B. Whitman of Baltimore has been appointed a member of the Public Service Commission of Maryland to fill the vacancy caused by the death of James C. Legg. Mr. Whitman is a member of the firm of Norton, Bird & Whitman of Baltimore, Chicago and New York. He is a graduate of Cornell University and has devoted much attention to sewerage and water-supply work, serving the city of Baltimore as water engineer and president of its water board until 1914. During the war he served as officer in charge of utilities, Quartermaster Corps, Camp Meade, Md.

E. Donald Tolles, who has recently been appointed to new duties as national representative of the Electrical Supply Jobbers' Association, was formerly secretary of the Atlantic Division of the Electrical Supply Jobbers' Association and was in addition secretary of the National Electrical Credit Association up to about a year ago. Mr. Tolles has been prominently identified with association work for a number of years. After a business career extending over several years he became associated with Franz Neilson in managing a number of trade associations. Five years ago he became secretary of the Atlantic Division of the jobbers' association and first assistant to the general secretary, Franklin Overbagh. During the war he was active in Washington in the interests of the industry, particularly in looking after the activities of the jobbers, and

E. D. TOLLES

assisted in drafting "Circular No. 23," which provided for the certification of electrical supplies. He is a graduate of Amherst College of the class of 1899 and a member of the New York State bar.

W. A. Porterfield, formerly connected with the enginering department of the General Electric Company, has been appointed general manager of the Union Metal Manufacturing Company, Canton, Ohio, in succession to C. L. Eshleman.

Obituary

Charles B. Schoenmehl, president of the Waterbury (Conn.) Battery Company, died recently.

J. F. Diehl, for many years president of the Santa Barbara (Cal.) Electric Company, died recently at his home in Santa Barbara. Mr. Diehl was born in Missouri in 1864 and moved to Santa Barbara in 1881, becoming an influential factor in the growth of that community through his connection with the electrical industry.

Trade and Market Conditions

Business Reviews, Together with Market Letters from Important Trade Centers, on the Supply, Demand and Prevailing Prices of Electrical Apparatus and Supplies

Sweeping Price Cuts on Western Cedar Poles

IN ORDER to do their share in bringing general prices to a level which will command public confidence and stimulate new activity in the industry, producers of Western red-cedar poles have announced decided price reductions. The extent of the cut, which was effective April 6, ranges in general from about 15 to 22 per cent. The new prices as compared with the old quotations on representative sizes are as follows: F.o.b. Chicago, 30-ft., 7-in. top, $8.50, $10.90; 35-ft., 8-in. top, $14.30, $16.25; 40-ft., 8-in. top, $16.80, $19.80. The same poles f.o.b. New York show the following new prices compared with the old: 30-ft., 7-in. top, $9.55, $12.20; 35-ft., 8-in. top, $16.10, $18.30; 40-ft., 8-in. top, $19.15, $22.40.

In addition to this decrease there is a further reduction of 6 cents per hundredweight based on the weight of poles at time of shipment, allowable as the result of lower freight rates which went into effect on Western red cedar poles April 1. On a 35-ft., 7-in. top pole this is said to amount to about 30 to 35 cents. The action of producers in dropping their prices, it is stated, is not entirely justified by lower costs, but in view of the tendency of consumers to hold off buying, it is taken in the hope that business will be stimulated thereby. Northern white-cedar poles as yet remain unchanged in price but the Southern white-cedar product was reduced about 15 per cent more than a month ago.

Demand at present is not large but seems to be on the increase, central-station companies especially showing considerable interest in the market. Electric railways are not placing many orders but producers are quite generally optimistic that before the year is out sales will have mounted to good proportions. Stocks of poles in the West are quite large, and as a result immediate shipments can be made to Eastern points. Sales west of the Mississippi are said to be in greater volume than nearer the Atlantic Coast, for in the latter territory demand has in large part been supplied by local chestnut poles, which are cheaper in first cost.

Ten per Cent Cut Marks Third Reduction on Line Hardware

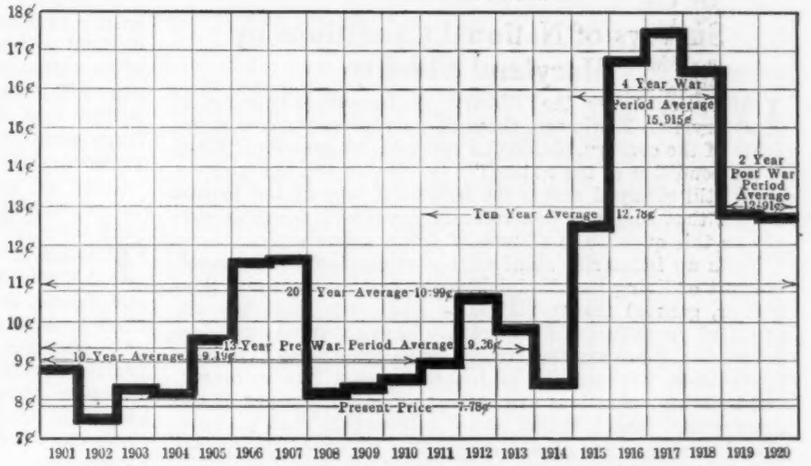
POLE-LINE hardware prices have again taken a drop. The reduction as announced by a leading manufacturer, effective April 11, amounts to about 7½ per cent, but this cut has been passed on by jobbers and distributers on an average of about 10 per cent. Other manufacturers are expected to follow suit in reducing quotations.

Prices quoted to electric railways and central stations by jobbers on representative material, f.o.b. Chicago, are as follows: Carriage bolts, ⅝ in. x 4½ in., $2.25 per 100 compared with $2.45 previously; cross-arm braces 1¼ in. x ¼ in. x 28 in., $13.25 per 100 as compared with $15; machine bolts, ⅝ in. x 12 in., $9.95 per 100 as against $11.15. Lag screws, 1½ in. x 4 in., are now priced at $4.25. General price reductions of from 5 to 7½ per cent were made on line hardware the middle of last February, and previous to that decreases of 5 to 15 per cent had been made during December and early January, so this is the third decided reduction that producers have made.

In general consumers have not entered the market very actively this spring, although demand from power companies is said to be increasing recently. As a result of the quiet market producers are only operating at from 50 to 75 per cent of capacity. Reserve stocks are sufficient to care for all needs with prompt shipments.

Copper Wire Costs and Contributing Metals' Prices

THE accompanying graph shows the average composite selling price of the four metals entering into the manufacture of standard copper cable for the years 1901 to 1920 inclusive and for various shorter periods during that time. The composite price, as may be seen from the tabulation below the graph, is arrived at by taking 10 lb. of cable as a basis and determining the percentage of each metal used and its price per pound. These prices are multiplied by the number of pounds of the metals used, and the addition of the results, divided by ten, gives the composite price of 1 lb. of the four metals.



COMPOSITE COST OF COPPER, LEAD, ZINC AND TIN FOR TWENTY YEARS

The composite price movement, indicated by the heavy black curve, shows that only once in the last twenty years has it gone below the present price, this being in 1902, though in 1908 and 1914 the curve went almost as low as at present. The price curve has not been carried beyond Dec. 31, 1920, but the present price is indicated by the lowest dotted line.

METAL PRICES AS OF MARCH 22, 1921

Per Cent	Pounds	Metal	Price	Extension
40	4.0	Lead	4.00 cents	16.000 cents
30	3.0	Copper	12.00 cents	36.000 cents
25	2.5	Zinc	4.75 cents	11.875 cents
5	0.5	Tin	28.00 cents	14.000 cents
100	10.0			77.875 cents

Briefly the graph shows that prices of the four principal non-ferrous metals are unquestionably low today. It can be seen that expressed in percentages present prices are approximately 15 per cent below the ten-year average from 1901 to 1910, 17 per cent below the thirteen-year pre-war

period, 40 per cent below the ten-year average from 1911 to 1920, 50 per cent below the four-year war period and 30 per cent below the average for the entire twenty years.

Since this chart was prepared the metal prices have advanced so that on April 12 New York spot prices, as shown in the metal table at the bottom of this page, will bring the composite price as of that date to 8.30 cents. Composite prices, however, are average yearly prices.

The graph was prepared by Paul Rich of the National Conduit & Cable Company.

Steel Corporation Reduces Prices

EFFECTIVE at once, the United States Steel Corporation, through Judge E. H. Gary, chairman of the board, on Tuesday announced reductions in prices of many of its products ranging from $1.50 per ton to $15 per ton. Reductions on tubular goods and sheets, it is understood, will be announced later. Steel rails and wire nails are unchanged.

The new price schedule, which supersedes that which went into effect in March, 1919, and which was approved by the Industrial Board, effects a reduction of $9 a ton in plates, $5 in structural steel, $5 in bars, $9 in wire rods, $7 for plain wire, $8 for sheet bars and small billets, $4 for slabs, $1.50 for 4 x 4 and heavier billets and $15 a ton for tin plates. The reductions in percentages range from 3.8 to 17 per cent. Although no statement was made regarding a reduction in wages, it is thought that this will follow.

Surveys of National Conditions by Maryland Fidelity

LAST September the Fidelity & Deposit Company of Maryland, Baltimore, through its representatives in all parts of the country, obtained a reply to the question, "What is the condition of the nation?" In view of the big question mark still stamped across the industrial map of the United States, that company has recently completed a second survey on this question, a résumé of which follows.

From an industrial standpoint cancellations have ceased, the cost of living has diminished appreciably since last September, general transportation is good, raw materials are plentiful, no failures of importance have occurred since last September, there are few strikes, wage reductions have been appreciable, productivity of labor per man has increased, and building operations are increasing in all sections of the country but New England and the Mountain States. Low-priced dwellings are needed most badly all over, warehouses and factories in New England, and high-grade dwellings and apartments in the Middle Atlantic, East North Central, West North Central and South Atlantic States.

Sentiment is not in favor of proceeding with building operations at present cost. There is no marked resumption of industrial activity, and buying by the public is still restricted. Retail prices have not been reduced in the same proportion as wholesale prices, and industrial concerns are carrying large amounts of customers' paper. Taxation and the railroad situation are indicated as having the greatest bearing on business prosperity.

As regards the financial situation banks are supplied with funds to lend except in the South Atlantic and Mountain States. From 6 to 8 per cent is the prevailing rate of interest, but the West South Central States go as high as 10. Over a six months' period deposits have generaly decreased, as have corporation accounts. Local indications all over point to lessened government tax revenue this year. All the states except the South Atlantic, East South Central and West South Central desire a higher tariff.

Touching the agricultural situation, farmers have not disposed of last season's crops and the crop outlook this season is from fair to good. Farmers are reducing their acreage, except in Illinois, Iowa, Kansas, Missouri, Nebraska and the Pacific States, because of low prices, shortage of labor and of money. They are not withholding payment of bills in the New England and Middle Atlantic States, but in all other sections lack of funds is given as the cause for withholding payments. The condition of sheep and cattle men is shown to be fair except in Kansas, Nebraska and the Mountain States, where it is poor.

The South and Reduced Cotton Acreage

IN THIS section of the issue for April 2 it was brought out that at the meeting of the Georgia Bankers' Association held in Macon on the twenty-third of March 50 per cent of last year's cotton crop was reported still in the hands of the farmers and that the reduction in cotton acreage this year will be 33 per cent. It is interesting in this connection to quote an editorial from the March 24 issue of the *Manufacturers' Record* regarding this question.

"If Southern bankers and merchants as well as cotton farmers will make a continued effort to force the cutting of cotton acreage to the very quick," says the editorial, "in order to make certain that even under the best conditions we could not raise over 5,000,000 or 6,000,000 bales, and let all the work which is usually given to plowing and planting and cultivating and picking a larger acreage be devoted to something else, notably road building and construction, the South can save itself from continued business depression and bring about a quick revival. As far as may be possible the South should be absolutely self-supporting in the way of foodstuffs for the coming year. It should be able to live at home more completely than it has done for the last fifty years, and if this policy be carried out and the cotton acreage be cut down to not more than half, at the outside, of the average acreage, the danger of continued depression will be largely eliminated and the South will have re-established itself on a firm foundation."

It is rather difficult for the country at large to feel as keenly as does the South the absolute dependence of the industrial activity of that section on the production and sale of its cotton crop. If, however, a reduction in acreage this year will re-establish the South industrially on a firm foundation, then the electrical industry should be interested to learn what steps are being taken to end the present depression.

The Metal Market Situation

THERE is no actual change in the copper market since the recent firming of prices. The advance has been maintained, copper over the second quarter being held at 12.75 to 13 cents per pound. On the other hand, offerings of copper for prompt shipment in the outside market at 12.75 cents are reported to have met with scant attention. Domestic demand is light, it is true, but the buying from abroad is better than had been expected in view of conditions there. Germany remains the chief purchaser and is paying cash.

The lead market has held its own since the advance of a week ago, but the buying movement that seemed to be started early this month has dwindled and the present market is not very active. There is more inquiry for zinc, but it seems to result from a belief that present prices represent a bargain rather than from any need to replenish stocks. The scrap-metals market is quiet, the only activity there being for lead scrap in conjunction with the advance of the parent metal.

NEW YORK METAL MARKET PRICE

	April 5, 1921	April 12, 1921
Copper	£ s d	£ s d
London, standard spot	68 7 0	69 0 0
	Cents per Pound	Cents per Pound
Prime Lake	12.75—13.00	12.75—13.00
Electrolytic	12.50—12.75	12.75
Casting	12.00	12.00
Wire base	15.00	14.50
Lead, trust price	4.25	4.25
Antimony	5.12	5.12
Nickel, ingot	41.00	41.00
Sheet zinc, f.o.b. smelter	11.00	11.00
Zinc, spot	5.15	5.15
Tin	28.75	29.75
Aluminum, 98 to 99 per cent	28.00	28.00

OLD METALS

	Cents per Pound	Cents per Pound
Heavy copper and wire	9.50—10.25	9.50—10.25
Brass, heavy	5.50— 5.75	5.50— 5.75
Brass, light	3.75— 4.00	3.75— 4.00
Lead, heavy	3.50— 3.65	3.50— 3.75
Zinc, old scrap	2.87½— 3.00	2.87½— 3.00

THE WEEK
IN TRADE

Prices When Quoted Are Those Prevailing at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

A CONTINUED slightly improving market is reported in the electrical supply industry, but no startling improvements are seen. High labor costs are responsible today for there being less building under way than was anticipated; still, building is on the increase in almost all sections of the country. In the South building labor is accepting a cut to help stimulate the industry. In Chicago the legislative investigation into building practices is holding up activity and the Building Trades Council is balloting on a 20 per cent wage reduction.

Trade generally is optimistic. Collections are still difficult and are running a little slower on the West Coast. Motor-driven appliances are moving in good volume, but other socket devices are very quiet. Large stocks of heaters probably will be left over because of the warm spring. Fans are moving slowly.

NEW YORK

Virtually all local jobbing houses report a larger total volume of business for March than in January or February, but in view of the weak condition of the market in many lines there is still much room for improvement. The heating-appliance trade is dead, heaters are not selling, the lamp trade has started its usual spring slump, and fans have not begun to move. Demand for staple supply items, too, is only fair at best, but, on the other hand, what is probably more significant is that most supply houses now report that sales are on the up grade. Furthermore, the general view is that this trend will continue.

Collections on the whole are spotty but no worse at least, and several jobbers are finding them satisfactory. Stocks are held low and buying continues very cautious. One house is inaugurating a 10 per cent wage cut and at least one has released a couple of salesmen.

The scale on which building construction work is contemplated in this section is encouraging. In New York State and northern New Jersey building contracts let during the month of March totaled $29,772,000, an increase of nearly 40 per cent over February. More than half of this total was for residential construction.

Flexible Armored Conductor.—Some small quantity is moving, but the market remains quiet. Stocks are considered fair, with No. 14, two-wire, double-strip bringing from $62 to $65 per 1,000 ft.

Fuses.—Stocks are about normal, but the supply moves only slowly. In standard-package quantities the N. E. C. standard 30-amp. non-renewable fuse sells for 10 cents each, though as high as 12½ cents is asked. Plug fuses in this specification are worth 4 to 4½ cents each.

Conduit.—Good stocks are held, but demand is small. In 2,500-ft. lots prices quoted this week on ½-in. black range from $63.58 to $72 per 1,000 ft., ½-in. galvanized from $68.68 to $76, ¾-in. black from $83.72 to $94.50, and ¾-in. galvanized from $90.62 to $97.75.

Metal Molding.—Some of this material is moving, but not a great lot. Stocks are held to fair levels. In 1,000-ft. lots the three-wire to four-wire size brings from $62 to $72.

Rubber-Covered Wire.—Fairly large stocks are held, still too much so in a few instances, but demand holds off. No. 14 single-braid in quantities of 10,000 ft. sells for $7.50 to $7.75 per 1,000 ft. Manufacturers report a slight improvement in demand just recently and express optimism over a returning market. A large producer has just reduced base price from 18 to 16 cents.

Flush Switches.—Limited stocks are mostly carried, for demand is light. Jobbers do not expect to buy more for some time apparently.

Panel Boxes.—The call is mostly for small sizes, and these are the ones jobbers are carrying, but both demand and stocks are light. One-day deliveries can be obtained from manufacturers.

Lamps.—The usual spring slump in demand is reported, and this will probably be augmented when daylight saving is inaugurated locally the last of the month. Most jobbers state that sales are normal for this time of the year.

Heaters.—There is absolutely no movement in this line, the exceptionally early warm weather thus far having killed the usual spring sales. Some jobbers are caught with much too heavy stocks, but many others have only a low supply. Price cuts have not been made.

Lamp Cord.—The Rome Wire Company on April 5 reduced the price of all cotton and silk cord 10 per cent.

CHICAGO

The past week has been absolutely devoid of movement so far as price changes in the electrical field are concerned, and demand remains likewise stagnant. Features in the business world out of the electrical industry, yet materially affecting it, are of great interest. The most promising development was the award of a contract for the construction of 15 miles of highway by the state. Concerning the construction field the reduction in the price of common brick from $16 to $12 per 1,000, announced this week as effective April 11, is of great importance as, with the exception of lumber, this is the first of the building materials to recede very far from the peak of high prices established in 1920.

All week the various unions in the Building Trades Council have been balloting on the proposition of a reduction in wages approximating 20 per cent, to be effective May 1. Many millions in construction contracts are held up pending the wage decision, and should the unions decline the cut it is freely predicted that for the first time in many years construction will be attempted on a large scale in Chicago under the open-shop rule.

Electrical jobbers report collections as very difficult. The agricultural districts contributary to Chicago are still burdened with a large portion of last year's crops and are correspondingly short on cash. Accounts receivable on the books of most jobbers are not so great in volume as was the case last year, owing to the decline in the volume of sales, but the average date of collection has extended from around fifty days in March, 1920, to around ninety days for last month. It is a condition which holds no hope of correction until the farmer class convert more of their crops into money. This condition, combined with an accumulation of fairly heavy stocks, is giving the jobbers as a class all the burden they care to handle.

Bare Copper Wire.—The cessation of production on the part of certain copper-mining companies has had a tendency to stiffen quotations, but bona fide offers to purchase in quantity can obtain as low a price as ever. Actual demand is at a minimum and quotations are reported as nominal. In 500-lb. lots No. 8 is quoted at 19 cents and No. 10 at 21 cents per pound.

Insulated Wire.—Very light business is reported in inside wire owing to peculiar conditions existing in the building industry. Ample stocks of all sizes and styles are available, and prices are subject to some variation in accordance with the needs of buyer and seller. No. 14 rubber-covered, 5,000-ft. quantity, is $8 per 1,000 ft., No. 6 triple-braided, weatherproof, in 1,000-lb. lots, is 19 cents per pound.

Black Conduit.—Light demand and a desire to reduce stocks on the part of certain jobbers has made it possible to buy small lots of ½-in. black conduit at $1 to $2 below the quoted figure of $64 per 1,000 ft. This quotation is still adhered to by the larger houses which state that any change is dependent on steel prices.

BOSTON

Spotty market conditions prevailed at the beginning of the week. Continued labor troubles appear to be the chief obstacle to a healthy increase in business. Inquiries are multiplying in many lines and a more hopeful tone is apparent among distributers. Collections are slow and part-time production is widespread. Requests for quotations, however, are much more numerous in jobbing circles. Contractor-dealers are buying on a moderate scale despite the curtailment in building work due to strikes. Stocks, while low in relation to normal demand, are easily meeting current requirements. Non-employment is extensive pending acceptance of wage reductions.

Motors.—Small sales are being handled. Inquiries are light, but considerable interest is being shown in motor application and occasional requests for bids are thoroughly in earnest. Prices are steady and stocks are heavy.

Tape.—Little tape is moving, but deliveries are excellent. The ¾-in. black friction tape sells for 45 to 39 cents per pound in 100-lb. lots, according to quality.

Lamps.—The supply is plentiful and a fair trade is being handled. House-wiring installations are proceeding well in interior New England, and a heavy staple business is always being done in renewals. Portables are moving in response to price concessions.

Washers and Cleaners.—Trade is improving. A leading distributer states that his March business exceeded February's and that April bids fair to double the March sales. Production is increasing at the factories, one large house being back to about 75 per cent of capacity on day runs. Prices are holding firm.

Ranges.—More orders and well-distributed business are reported. The outlook is good for an active season. Recent price changes have helped to stimulate interest, and if the building situation improves orders will increase.

Wire.—Large stocks are available for immediate delivery in quantity. Trade is fairly good considering the labor situation. No. 14 rubber-covered wire sells for $8 per 1,000 ft. in 5,000-ft. lots, and for $8.75 in 1,000-ft. consignments. Weatherproof is moving on bases varying with different makers, a representative price being 18.5 cents for 200 lb. or more of No. 6. No. 0 sells at around 17 cents in 200-lb. lots or over. Bare copper wire is moving very slowly at about 15 cents base.

Rigid Conduit.—A quiet market is noted. Good supplies for present needs are in hand. Black pipe, 1-in. diameter, sells for $131.20 per 1,000 ft. in 5,000-lb. lots, the ½-in. black bringing $67.30.

Flexible Armored Conductor.—Little of this material is moving and prices are steady on the whole. In 2,500-lb. lots or over No. 14 double-strip commands $65 to $67 per 1,000 ft. Stocks await a building boom.

Lamp Cord.—Boston price on No. 18 cotton-covered, twisted cord is $18 per 1,000 ft. in 1,000-ft. lots, the No. 18 silk cord selling at $34. A fair demand is being handled.

Fans and Radiators.—Stocks appear too large to require much buying at present, but these products are developing a staple trade which is not limited by seasonal conditions.

ATLANTA

A slight increase in the activities of the electrical jobbers has given a firmer feeling to the electrical business as a whole, a majority of the leading firms reporting an encouraging increase in their March business over the prior months. Most of the activities, however, are on a smaller scale than was the case in 1920. Consulting engineers and contracting firms are beginning to receive inquiries regarding construction of various types, inquiries for municipal and educational types predominating. It is the general opinion that the reduced price of building material, combined with reduced labor cost and the increased efficiency of labor, is beginning to be reflected in construction of the more inexpensive type of dwellings, and propaganda is being used to encourage such activity. The local bricklayers' and masons' unions have voted to accept a reduction of 12½ per cent in wages for the purpose of stimulating local activities. This undoubtedly will be followed by reductions in allied lines and, it is felt, cannot but have a beneficial effect on conditions in general. The rural districts are showing considerable interest in the promise of the national government to assist in financing the export of cotton, and the feeling that conditions are due to better themselves soon in the rural districts is quite in evidence.

Air Heaters.—The recent sharp snap caused a temporary movement in this line but not sufficient to prevent dealers carrying over heavy stocks to next season. Little further activity is looked for in this line until fall.

Distribution Transformers.—In company with pole-line material the movement of this line is reported satisfactory, municipalities placing a fair volume of the orders. Stocks are reported in good shape with shipments satisfactory.

Lamps.—Lamps constitute one of the few lines that are apparently on a normal demand basis, the volume of sales approximating that of the same period last year. The demand for 50-watt white lamps is reported on the increase and, as usual, the 75-watt type-C maintains considerable popularity.

Tape.—Low stocks are the result of this item showing unexpected life; orders are being received in satisfactory volume, and purchases are much larger in unit volume than usual. The price is steady at 41 cents.

Ranges.—Heavy stocks have accumulated in the hands of numerous jobbers, little activity having as yet evidenced itself in this line despite the price reduction of several weeks ago.

Safety Switches.—The demand for this article continues brisk not only in the larger cities but also in the smaller towns, the greatest demand apparently being for the 60-amp. and 100-amp., three-pole type. Local stocks are in fair shape and no change in price is to be noted.

Meter Trim.—The policy of some central stations to insist on the installation of meter trim in connection with safety switches is on the increase, and the demand has caused stocks to become somewhat spotty. Jobbers anticipate a steady demand for this item.

ST. LOUIS

Very little change in the general condition of business was manifested here last week. There are encouraging signs of really good business in a few months, and in the meantime demand is showing gradual improvement. For stimulating more interest in building an "Own Your Home Exposition" is to be staged by the Building Industries Association the last week of this month. For the same purpose the State Legislature recently passed a law diminishing taxation on real estate loans. Prices on brick have recently been reduced and reductions in other building materials are gradually appearing. The housing shortage still exists. A small amount of residential building is under way. In the Oklahoma oil fields residential building is reported to be quite active. The principal deterrent seems to be the high labor cost, and there are no indications of an early reduction. Industrial building is at a standstill, but a number of concerns have plans to build as soon as costs warrant.

Credit conditions are about the same, the basis varying from forty-five to seventy-five days, with an average of about sixty days. Stocks are being brought to a better condition through interchange. Retailers' stocks are as a rule at the minimum, and steady orders for replacements are observed. Demand is still very low in the South except that Arkansas is showing some improvement. The territory to the north of St. Louis is showing appreciable improvement in demand.

Wire.—No. 14 rubber-covered shows a very competitive market and is moving at a fairly satisfactory rate. Quotations vary from $7.15 to $8 per 1,000 ft. in 5,000-ft. lots. There is some tendency to refuse to quote at the low prices in the expectation that the price will be higher before long. The larger sizes of rubber-covered are moving slowly. Weatherproof is on a 16-cent base, and bare wire is selling on a base from 15½ to 16½ cents.

Knobs and Tubes.—The previously heavy stocks are being

satisfactorily reduced by most jobbers, though the selling price remains at about $23.80 per 1,000 for "Nail-it" knobs and $8 per 1,000 for 2½-in. tubes.

Conduit.—Slight improvement in demand is noted and contractors are replenishing their stocks. Stocks in hands of jobbers are in good shape. Slightly lower prices prevail, ½-in. black selling from $61 to $70 per 1,000 ft.

Ranges.—The present demand is very low, but in view of increased gas rates and lower retail prices concurrent with the increased interest as summer approaches, the trade is making preparations to push sales. Inquiries are becoming more numerous. Stocks are in good shape.

Washing Machines.—A steadily improving demand marks the washing-machine business, and it is now about normal. Stocks are being maintained at low inventories.

Vacuum Cleaners.—Demand is improved and can be said to be about normal. Stocks in the hands of some jobbers are reported to be excessive.

SAN FRANCISCO

Business is fair but rather quieter than at the beginning of the month, when a great number of advanced schedule orders were shipped. Collections are a little slower. The California Co-operative Campaign reports a very gratifying return from its educational work in furtherance of good illumination. In fact, one manufacturer states that the demand for certain schedule material has increased about 30 per cent because of this educational work. To supplement in the merchandising field the very excellent work of the California Dealers and Contractors' Association there has been formed an association primarily of dealers, who are gradually formulating some effective merchandising methods.

Conduit.—Very good jobbers' stocks of rigid iron conduit, both black and galvanized, are reported despite the canceling of heavy pre-scheduled shipments. The dealers' demand is quite light, being confined to small buildings, although in a few weeks it may be that large buildings under construction will be ready for heavy shipments.

Conduit Fittings.—Lock-nuts and bushings are correspondingly slow with other roughing-in staples. The present price of ½-in. bushings in standard package lots is $2.16 per 100 and of lock-nuts $1.17 per 100.

Fuses.—The renewable-fuse situation is sifting itself down to a few standard makes and to a demand that is practically confined to industrials. The present price on standard-package lots of the original fuse and container is approximately 32½ cents each for the 30-amp. size, 65 cents for the 60-amp. size and $1.30 for the 100-amp. size, a decrease of about 10 per cent from previous prices.

Tape.—Commercial grades of friction tapes are selling for about 47 cents per pound in 100-lb. lots and rubber tapes for about 40½ cents.

Ironing Machines.—Although sales of practically all the household appliances have markedly decreased, yet ironers have not fallen proportionately. The result of missionary work is now apparent. Local stocks are very good.

Ranges.—Edison ranges were recently refigured in prices so as to give the dealer an excellent margin, the reason being, it is stated, an accumulation of stock at the factory because of a sudden sharp decline in jobbers' orders. These new dealers' prices are effective only for a limited period, virtually covering the rest of the month. So far, however, the acceleration of business has been rather slight.

SEATTLE—PORTLAND

Spring weather, which is prevailing generally throughout the entire Northwest, has been the determining factor in causing city, county and state officials to start street-improvement programs which have been in the making since the first of the year. It is also the reason for increasing the amount of new construction. Optimistic feeling along all lines is far more prevalent than at any time so far this year, and it is generally believed that 1921 will still give a good account of itself. The outfitting of ships in Seattle for the annual fishing and packing operations in Puget Sound and Alaskan waters has started. Recently orders in a considerable amount for electrical equipment for Alaskan mines have been placed, and this business is expected to develop during the next thirty days. Manufacturers in both the Portland and Seattle fields report business about the same. Jobbers report a slight pick-up in sales volume with a tendency toward buying in standard-package lots.

Contractors in both Seattle and Portland report an appreciable improvement in business, most of which, however, is confined to small industrial buildings and residences. Portland territory states that there is a great deal of activity in residence construction, the number of building permits issued during March being 50 per cent greater than for March of last year. Dealers in Seattle and Portland and throughout the Northwest generally report business slow but showing a slight improvement from week to week, the greatest activity being in sales of washing machines, vacuum cleaners and electric tableware.

Schedule Material.—Jobbers report business along this line picking up gradually, but say that increases are not up to original predictions or expectations. Orders, while quite numerous, are small.

Motors.—Inquiries are much heavier, and some sales, particularly of smaller sizes, are being made. The greater part of the movement is to lumber mills which are electrifying planing mills and box factories. Jobbers' stocks are equal to current demands in all sizes. The second-hand market is comparatively active.

Conduit.—Galvanized pipe in the past two weeks has shown some activity. Jobbers are not buying in large amounts. As a result stocks in some sizes are running low. The movement in flexible conduit is sluggish, but during the past week a slight increase in buying was noted despite rumors of a decrease in price.

Street-Lighting Equipment.—This line has shown some movement this spring, and it is believed that sales during the year will be in fair volume. Demand from small municipalities is for both standard and ornamental types.

SALT LAKE CITY—DENVER

With the full advent of spring there is a noticeably better feeling in business circles. The consuming public is buying more extensively in all lines of merchandise, apparently in the belief that downward prices have hit the bottom and become somewhat stabilized. Seasonable merchandise is particularly in demand, including building materials, wiring materials and hardware. Building activity is getting under way, especially the construction of homes. Collections are little improved and banks are still conservative in the granting of loans. There is a persistent hope that the shutdown of the copper mines will be only temporary. In the meantime lack of employment will have a rather depressing effect on business generally.

Ranges.—No general price reduction has come to the notice of jobbers to date. One of the largest American manufacturers, however, is unloading overstock at something like a 15 per cent cut. It is only a special concession but one large jobber reports good sales on the strength of it. All jobbers and dealers are looking forward to a good range season.

Motors.—There is a steady call for motors of small power rating, especially sizes ranging from 2 hp. to 10 hp. Jobbers are adequately stocked and ordering liberally in anticipation of good business. Several large irrigation projects now under way have called for the installation of motors of 300 hp. to 1,200 hp. Indications point to a larger and larger motor outlet in this direction.

Fans.—Dealers are making active preparation for a good fan summer, and several fine orders have already been placed with jobbers. Present stocks are varied and plentiful, and sizable orders are being placed with the factories for future delivery.

Conduit.—The demand is showing a slight pick-up with the growing activity of contractors incident to home-building operations. Price cuts range between 10 and 15 per cent. Deliveries are good.

Manufacturers' Activities

Devoted to the Business Side of Manufacturing, Distribution and Sales, News from Jobbers and Foreign Fields and a Record of New Devices and Trade Literature

New Factory Put Up by Davidson Porcelain Company

The Davidson Porcelain Company, with post office address at East Liverpool, Ohio, and factory at Chester, W. Va., has erected a new factory with a six-kiln capacity. The company makes the "Eveready" non-assembled knob and a complete line of standard porcelain.

Expansion Provided for Lewis Electric Company

Following the increased demand for its "Kantshok" products among central stations and contractor-dealers, the Lewis Electric Company, Canton, Ohio, has recently increased its capitalization from $100,000 to $500,000. With this additional capital the company hopes to be able to increase its production materially at once and within the near future to build a new plant so that its complete product will be manufactured under one roof. The company's desire is to make not only its metal parts but also its porcelain parts as well.

Arrangements have been made with H. Lee Reynolds to take charge of sales in the Pittsburgh territory. His offices will be in the First National Bank Building, Pittsburgh.

Dealer Returns Show Good Hoover Sweeper Business

According to the April 5 *Point Sheet* of the Hoover Suction Sweeper Company, North Canton, Ohio, Hoover dealers report from all over the country that business is running at a very satisfactory rate and that sales campaigns on the company's sweepers are returning excellent results. Many dealers, central stations and distributers are predicting much heavier sales in 1921 than those experienced in any past year.

Canadian Westinghouse's 1920 Report Shows Gain

From the seventeenth annual report of the Canadian Westinghouse Company, Ltd., Hamilton, Ontario, business for the fiscal year ended Dec. 31, 1920, brought in net earnings of $916,080 before deducting dividends, so that $300,555 was added to the previous balance to make the balance carried forward Jan. 1, 1921, $2,114,828. Earnings from manufacturing operations amounted to $2,020,516. Contracts in progress represent $128,425, while inventory of materials and products on hand, including work in progress, less collections on account, are $4,637,501.

For the purpose of obtaining additional working capital, made necessary by the increased business and activities of the company, the outstanding capital stock was increased during the year from $6,229,400 to $7,417,900. By mid-year, 1920, a realization began to be felt generally throughout the community that, although no overproduction of goods existed as measured by the world's needs, the question of payment for further production, particularly on the scale of prices prevailing, would have to be seriously considered for the future. A dropping off in export absorptions and the continued low exchange rate on Canadian funds were indications that could not be overlooked. Billings marked a new high record, and orders scheduled for delivery on into 1921 are equivalent to an average full output of the plants for several months. Accounts and bills receivable amounted to $2,530,863 on Jan. 1, 1921.

During the year the company took up the manufacture of incandescent lamps besides extending its activities along other lines.

R. W. Lillie Corporation Opens New Territory

The R. W. Lillie Corporation, which recently moved to larger quarters at 50 Church Street, New York City, has just opened an office in the Engineers' Building in Cleveland. C. H. Purdy, operating from Cleveland will be in charge of both this office and the new one just opened in the Oliver Building, Pittsburgh, covering Ohio and part of Pennsylvania. The accounts handled in these new offices will be Jeffrey-Dewitt Insulator Company, Electric Power Equipment Company, Maring Wire Company, Collyer Insulated Wire Company, and T. & W. Electrical Manufacturing Company for Ohio and part of Pennsylvania, and Electro Service Company's Bennett surge arresters for part of Ohio only.

The Boston office has also recently taken on the representation in New England of the Packard Electric Company.

New Warehouse for Bryant Factory

The Bryant Electric Company, Bridgeport, Conn., has completed a four-story-and-basement steel and brick building which will be used as a finished-goods warehouse and shipping department. The building is T-shaped and covers approximately 224 ft. by 60 ft. of ground area, or more than 67,000 sq.ft. of floor space.

N. E. C. A. Program for Richmond Meeting

Business, Business Methods, Credit and Collection Problems and the Association to Be Discussed on May 19 and 20 by the National Electrical Credit Association

For the twenty-second annual meeting of the National Electrical Credit Association, Secretary F. P. Vose, Marquette Building, Chicago, has announced a tentative program to occupy the two days of May 19 and 20 at the Hotel Jefferson, Richmond, Va. Besides the business program, time will be allotted for visits of an historical nature and a golf tournament is provided. Francis H. Sisson, vice-president of the Guaranty Trust Company, New York City, and W. J. Harahan, president of the Chesapeake & Ohio Railroad Company, will address the annual dinner.

On Thursday's program John M. Miller, president of the First National Bank, Richmond, will present "The Business Outlook"; J. A. Corcoran, General Electric Company, will consider "Better Business Methods"; "Effect on Sales of Rigid Credit Policy" and "Present-Day Credit and Collection Problems—How to Meet Them" will be discussed by a member of the New York and a member of the Chicago association respectively.

A Philadelphia member will lead the discussion on Friday on "Is the Credit Man a Business Builder?" The subject allotted to Thomas W. Wheelright, president of the Virginia Railway & Power Company, is "Public Utilities—Have They Seen Their Worst Period?" James A. Loring, secretary of the New England association, will commence the discussion on "Handling the Slow and Embarrassed Customer."

Of the additional themes that are scheduled, "Association Problems and Remedies" will be led by Albert H. Elliot, secretary of the Pacific Coast Association. Others cover the "Marketing of Household Devices," "Revision of Income Tax Law," "Business Conditions in the South," "Value of Accounts Receivable of Dealer-Contractors," "The Sales Manager's Viewpoint of the Credit Department," "Value of E. C. A. Membership," "The Function of the American Finance Corporation" and "Electric Credit Clubs."

Swiss Refrigerating Company's American Representation

Esher, Wyss & Company, Switzerland, about three months ago began representation in this country through Joseph Roschach, 202 Main Street, Paterson, N. J. Since the New York office was opened with the William Stickel Company, 140 Fifth Avenue, Mr. Roschach has been negotiating for representation in several other cities of the United States.

The company uses carbonic-acid gas as the refrigerant in its "Carbona"

refrigerating and ice machines, built both for household and commercial use. At present, however, only commercial machines are being imported into this country, but it is the intention to introduce residential types in a year from now. A factory is maintained at Campgaw, N. J., for servicing machines and for replacement parts. It is the intention to carry stocks of finished machines in this country as soon as those stocks can be accumulated. Machines now in transit are already purchased, and about six months' shipments are quoted on new orders. Very satisfactory sales are reported as a result of the Refrigerating show held last week by the New York Edison Company.

Larger Quarters for Metropolitan Electric Protective Company

The space at 130 West Twenty-sixth Street, New York City, having become too small for its office force, the Metropolitan Electric Protective Company has moved to 253 Seventh Avenue, where it has about 25 per cent more space for this department. The basement, first and second floors of the building, which is 25 ft. x 80 ft., have been leased and are being used now. Factory location remains unchanged at 52 West Twenty-second Street, where the company produces alarm systems for its protective service and direct-current interior fire-alarm systems.

Pierce Electric's Recent Purchase for Expansion

The Pierce Electric Company, Tampa, Fla., has just completed purchase of the wholesale department of the Jacksonville concern of Livingston, Young & Company, which includes the state agency for the manufactures of the Westinghouse Electric & Maufacturing Company. The Jacksonville purchase will be maintained as a branch, the main business remaining in Tampa.

"We have been going quietly ahead with our preparations for expansion," said President J. F. Pierce of the company. "Recently we increased our capitalization from $50,000 to $125,000, and we are building a two-story concrete warehouse on South Franklin Street which will soon be ready for occupancy. This structure which is 100 ft. square and is being constructed of fireproof material—reinforced concrete—with a concrete roof is so arranged that we can add a third story at comparatively small expense when the business demands more room." The other officers of the company are: W. G. Pierce, vice-president, and Bryant E. Pearce, secretary-treasurer.

Norwalk Iron Works Expanding Refrigeration Distribution

In order to take care of the increased distribution of its electrical refrigerating machinery for household and commercial use, the Norwalk Iron Works Company, East Norwalk, Conn., is adding new machinery and increasing its factory capacity and production. The Southern headquarters has just opened at Atlanta, Ga., with the Dixie Engineering Company.

Agencies have just been established with the Standard Scale & Fixture Company, Tampa, Fla.; W. D. Miller Company, Jacksonville, Fla.; Southern Supply Jobbers' Company, New Orleans, La.; Jarvis Engineering Company, Boston, Mass.; R. G. Halliwell Company, Chicago, Ill., and an agency is just being closed in Miami, Fla. Some central stations and holding companies are also acting as agents. The Paul E. Flotron Company, Philadelphia, has recently added this line to its branches in New York City and Baltimore. The company is also about to close agencies in Buffalo, St. Louis, Detroit and either Cleveland or Cincinnati. At all these locations stocks of finished machines will be carried.

With the reorganization of the company last November, E. Hill became president and C. L. Thompson treasurer and general manager.

U. S. Chamber of Commerce to Discuss Business Methods

The general theme of the ninth annual meeting of the Chamber of Commerce of the United States, to be held at Atlantic City April 27 to 29, will be: "In the public interest, more business methods in government, less government in management of business." Speakers will include government officials and leading business men in many lines of finance, commerce and industry. Much of the work of the convention will be done as heretofore in group sessions.

Treatment of wages, contract cancellations, better accounting methods and the need of national statistics on production will be taken up, and proper activities of trade associations also will be discussed. Other topics cover taxes, foreign commerce, natural resources, transportation, international finance, the tariff question, etc.

Mitchell-Rand Finds Better Sales of Insulating Compounds

The Mitchell-Rand Manufacturing Company, manufacturer of insulating compounds at its Jersey City (N. J.) plant and distributer of general insulating material through its office at 18 Vesey Street, New York City, reports that at present sales of the compounds, waxes, electrical insulating points, sealing material, etc., which it makes, are running ahead of its general insulation business. Cable manufacturers are beginning to order, for one thing, and, furthermore, producers making use of this class of material are finding it cheaper to buy rather than produce what they need and thus eliminate overhead cost. The company has neither reduced wages nor made a cut in working force. Present operation is at about 50 per cent of capacity. Fairly good stocks of the finished products are being carried, thus insuring immediate shipment of orders. The company is adding to its line the manufacture of "Macbeth's extra belt dressing," a compound designed to prevent belts from slipping. This was made by the company several years ago under the name of Steers Supply Company, but was afterward discontinued.

Workers' Viewpoint Broadened by Products Show

That the average worker is quite ignorant of the product turned out and of the individual efforts of his coworkers is generally conceded. This is especially true as the size of the plant increases. To offset this condition and to develop active, inquiring brains in its employees, the Western Electric Company, at its plant at Hawthorne, Ill., stages each year a product show where every type of machinery used in the factory and every little item produced in it are displayed in pieces, partly assembled and assembled and explained by demonstrators. For three days and nights the show is open to the employees and their families, and it is considered a big educational step in the industry.

Six Hundred Attend G. E.-Pettingell-Andrews Conference

A merchandising conference was held at the Copley-Plaza Hotel, Boston, March 24, under the auspices of the Pettingell-Andrews Company in conjunction with the General Electric Company and various affiliated manufacturing organizations, about 600 persons being present from all branches of the industry from every part of New England and many outside points. The conference followed the general lines of similar gatherings in other parts of the country at which merchandising topics have been discussed with demonstrations of equipment for domestic and commercial use. In calling the meeting to order, Frank S. Price, president of the Pettingell-Andrews Company, said that the success and prosperity of the electrical industry, and particularly the rapidity with which it moves forward, will largely depend on its merchandising ability.

The American Engineering Company, Philadelphia, maker of the Taylor stoker, has established a Mid-Western service station at 1772 West Lafayette Boulevard, Detroit. A complete stock of parts for all sizes and types of these stokers is carried and immediate shipments will be made, it is announced.

Hanson & Van Winkle Company, 269 Oliver Street, Newark, N. J., has filed plans for extensions and improvements to its plant, to cost about $25,000.

The New Jersey Lamp Works, 21 William Street, Newark, N. J., is reported to be receiving bids for a two-story addition, 25 ft. x 28 ft.

The Chandler Welding & Machine Company, Texarkana, Ark., is planning to install machinery for the manufacture of refrigerating equipment.

The American Thermostatic Company, Charlotte, N. C., recently organ-

ized, is making arrangements to established a plant to manufacture thermostats and other precision devices. C. L. Brookshire, 19 East Sixth Street, is president.

The Utility Compressor Company, Detroit, manufacturer of electrically controlled refrigerating equipment, is planning to move to Adrian, Mich., where it will erect a factory with a floor space of 20,000 sq.ft. The company is capitalized at $500,000 and was originally engaged in the manufacture of air compressors and vacuum pumps for garage and laboratory purposes, but for some time has been devoting its attention to refrigerating apparatus.

The Roller-Smith Company, 233 Broadway, New York City, has removed its Cleveland office from 230 Vickers Building to 7016 Euclid Avenue.

The Ideal Electric & Manufacturing Company has appointed Arthur Purdon as general sales agent for the Utah territory, with offices at 615 Newhouse Building, Salt Lake City. The home office is at Mansfield, Ohio.

The Reliable Machine Company, Bridgeport, Conn., has made arrangements with the Consolidated Wire & Machinery Company, 529 West Van Buren Street, Chicago, to act as sales representative for its magnet wire.

William G. Merowitz, 707 Ellicott Square, Buffalo, application engineer, has recently been appointed district sales engineering representative in Western New York, Erie, Pa., and nearby Canada for the products of the Ward Leonard Electric Company, Mount Vernon, N. Y.

The Brown Hoisting Machinery Company, Cleveland, Ohio, announces the opening of a Southern office at 530 Whitney-Central Building, New Orleans. The States of Texas, Louisiana, Mississippi, Alabama, Georgia and Florida will be covered from this office. Charles H. White is manager of the new office.

The Conveyors' Corporation of America, 326 West Madison Street, Chicago, announces the appointment of Robert B. M. Wilson as sales engineer of the Chicago district. E. M. Wolfe will be associated with him as an assistant. Headquarters will be maintained in the corporation's main office at 326 West Madison Street.

The Stearns Conveyor Company, Cleveland, recently organized to manufacture conveying and other equipment, has begun work on the erection of the first unit of its plant, consisting of a one-story building, 50 ft. x 200 ft.

The Black & Decker Manufacturing Company, Towson Heights, Baltimore, will be represented in the South by Thomas W. Peters, who has for the past fifteen years been located in Columbus, Ga. The Southern territory includes all the Southern states east of the Mississippi River. A regular branch office will be established at Atlanta, Ga., in the very near future, where Mr. Peters will make his headquarters.

The Eureka Vacuum Cleaner Company, Detroit, Mich., has moved its general offices, formerly at 101 Broadway, to its factory at Greenwood and Dewey Avenues, Detroit.

Foreign Trade Notes

EXTENSION TO ELECTRIC PLANT AT CARTAGO, COSTA RICA.—According to a report from Consul Guyant the Compañia de Luz Electrica de Cartago (Costa Rica) has been granted the use of additional water power near Cartago for the purpose of increasing the output of its plant.

DEMAND FOR ELECTRICAL EQUIPMENT IN BEIRUT, SYRIA.—Vice-Consul Frederick O. Bird of Beirut reports that there is a good market in that district for electrical supplies, principally wires, sockets, switches and lamps. The current used is alternating, 50 cycles, 110 volts. No electricity is used in the smaller towns.

TENDERS BEING ASKED FOR THE KOSTOLAC SCHEME, SERBIA.—Tenders are being invited by the Serb-Croat-Slovene Ministry of Public Works until May 1, according to the *Electrical Times*, London, for the construction of a power station, main conductors and transforming stations in connection with an electrical scheme at Kostolac to supply energy to Belgrade, Semlin and other places. Tenders should be addressed to the Director, Ministry of Public Works, Belgrade, Serbia. Translation of the specifications, together with a plan of the proposed works, may be seen at room 48, Department of Overseas Trade, 35 Old Queen Street, S. W. 1, London, England.

NATIONAL MOVEMENT IN THE NORWEGIAN ELECTROCHEMICAL INDUSTRY.—The Norwegian electrochemical industry before the war consisted mostly of firms operating under Norwegian methods but working with foreign capital. In war time a movement was started to create a national electrochemical industry in opposition to the foreign concerns. A number of purely Norwegian firms have sprung into existence since then. They have lately formed an association, the Landsforeningen for Elektroteknisk Industri, for the purpose of advancing the national interest and in favor of a protective tariff.

THE DELTA-STAR ELECTRIC COMPANY, 2433 Fulton Street, Chicago, has appointed the James J. Niven Company, Wellington, New Zealand, its agents for the unit line of switching and protective equipment.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

A trading company in Australia (No. 34,666) desires to purchase electrical goods, electrical wires and cables, etc. This company is desirous of obtaining suitable representation to keep it regularly supplied with quotations by mail and cable of all classes of merchandise suitable for the Australian market.

An industrial engineer in Spain (No. 34,667) desires to secure an agency for the sale of electrical supplies.

A builder and contractor in Mexico (No. 34,698) desires to purchase electrical material, etc.

Industrie Elettromeccaniche Comensi, Ireo Prosdocimi, Como-Via V. Barelli 6-8, Italy, announces that as the whole of its activity is in the electrical industry, it especially studies the small-size automatically operated generating plant, as it has become convinced that this type of machine will find great use throughout Italy. The hydroelectric problem is very seriously studied and methodically worked out in Italy. The above company, having made a survey of the industrial field, desires the addresses of all manufacturers who are interested in the production of small-size automatic generating plants.

New Apparatus and Publications

RADIOPHONE. — The DeForest Radio Telephone & Telegraph Company, 1415 Sedgwick Avenue, New York City, is distributing a six-page leaflet describing the DeForest type OT-3 "Midget" radiophone.

PUMP GOVERNORS.—The Atlas Valve Company, 282 South Street, Newark, N. J., having acquired sole rights to manufacture and sell the Ideal pump governors, is now distributing its first bulletin No. 1-4, edition No. 1, describing this governor.

ELECTRIC IRONS. — The Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa., has placed upon the market a new electric iron, known as the type H.

PUMPS AND CONDENSERS.—The Manistee Iron Works Company, Manistee, Mich., is distributing bulletin No. 101, illustrating its centrifugal pumps and rotary jet condensers.

RADIO PUSH SWITCHES.—The Hart & Hegeman Manufacturing Company, Hartford, Conn., has issued a four-page leaflet describing the "H & H" push switches with radio-active luminous button inserts and a radio-luminous pendant on "Paiste" pull sockets.

INSULATING VARNISH.—A black insulating varnish, "General Utility Inco Insulite No. 16," has been placed on the market by the International Paint Corporation, St. Louis.

ELECTRIC FURNACES.—Two new types of electric furnaces for melting non-ferrous metal have been developed by the General Electric Company. The 1,500-lb. size is for three-phase and the 50-lb. size is for single-phase.

REFRACTORIES.—"Clinker Proof Furnace Walls" is the title of a folder issued by the Bernitz Furnace Appliance Company, 15 State Street, Boston.

REFRIGERATION. — Bulletin No. 6 shows refrigerating plants of the Norwalk Iron Works Company, South Norwalk, Conn.

RADIO BATTERY. — Stuart Products Corporation, Chicago, is adapting its "Make-Ur-Own" batteries to radio work. Its "B" batteries are shown in a recent folder.

BLOWERS.—The "Coppus" turbo blower for undergrate draft and other industrial service is described in a recent publication of the Coppus Engineering & Equipment Company, Worcester, Mass.

LAMP GUARD.—The "Gripon," a closed-bottom, non-locking lamp guard, has been placed on the market by McGill Manufacturing Company, Valparaiso, Ind.

New Companies

THE AMERICAN LIGHTING & MANUFACTURING COMPANY, 800 Sibley Street, Chicago, Ill., has been incorporated by William J. and F. T. Davis. The company is capitalized at $100,000 and proposes to manufacture electric lighting equipment and appliances.

THE FARMERS' ELECTRIC COMPANY, Romney, W. Va., has been incorporated with a capital stock of $25,000 by J. W. Shull, James O. Blue and J. S. O'Hara.

THE HYDRO-ELECTRIC PYRO COMPANY, Jersey City, N. J., has been incorporated by Paul Andrea and Alfred H. Francfort, Jersey City, and Angelo Diani, Woodbridge. The company is capitalized at $200,000 and proposes to manufacture electrical appliances.

THE DALE LIGHT & POWER COMPANY, Dale, Ind., has been incorporated with a capital stock of $15,000 to furnish electrical service. The directors of the company are D. J. Wallace, P. W. Fuller, O. V. Brown and others.

THE POMEROY ELECTRIC COMPANY, INC., New York, N. Y., has been incorporated with a capital stock of $40,000 by S. S. Robinson, H. N. Bennett and B. H. Pomeroy. The company proposes to manufacture electrical equipment.

THE ALLIED ELECTRICAL DEALERS, INC., New York, N. Y., has been incorporated with a capital stock of $1,000,000 to manufacture and deal in electrical machinery and supplies. The incorporators are John J. Garrison, F. G. Haag and Ludlow S. Fowler.

Record of Electrical Patents

Notes on United States Patents

(Issued March 22, 1921)

1,372,603. TERMINAL STRUCTURE FOR ELECTRIC BATTERIES; Thomas R. Cook, Pittsburgh, Pa. App. filed March 10, 1920. For preventing escape of battery liquid.

1,372,634. METHOD OF AND APPARATUS FOR BRAZING; George A. Thornton, Port Washington, N. Y. App. filed Nov. 7, 1919. Electrically heating.

1,372,642. ELECTRICAL RESISTANCE ELEMENT AND METHOD OF PRODUCING SAME; John G. Clemens, Buffalo, N. Y. App. filed May 7, 1919. Lowering resistance as temperature increases to prevent heavy surge when starting motor.

1,372,650. IGNITION SYSTEM; Henry R. Davies, Toledo, Ohio. App. filed April 8, 1919. Without resistance coils or high-capacity condensers.

1,372,653. ELECTRICAL TRANSFORMER SYSTEM; Friedrich Dessauer, Frankort-on-the-Main, Germany. App. filed July 23, 1918. Voltage between windings reduced.

1,372,658. UNDERGROUND OR UNDERWATER ANTENNA SYSTEM; Edward T. Jones, New Orleans, La. App. filed April 11, 1919. For radio reception or transmission.

(Issued March 29, 1921)

15,073 (reissue). AUTOMATIC DISTRICT TELEPHONE SYSTEM; Harry E. Hershey, Whitewater, Kan. App. filed Oct. 29, 1918. Improved trunking apparatus.

1,371,908. CONVERTER; William C. Korthals-Altes, Schenectady, N. Y. App. filed Dec. 22, 1917. For converting alternating current into direct current.

1,372,678. ALARM DEVICE; Samuel M. Elsner, Newark, N. J. App. filed Oct. 7, 1919. To prevent theft of automobiles.

1,372,739. MAGNETO; Bruno Bonomini and Luigi Duca, Turin, Italy. App. filed Aug. 28, 1919. For ignition.

1,372,751. TESTING APPARATUS FOR INTERNAL-COMBUSTION-ENGINE IGNITION SYSTEMS; George L. Hogan, Chicago, Ill. App. filed June 28, 1920. For locating defects.

1,372,778. SOLDERING IRON; Roy G. Sands, Waukegan, Ill. App. filed Oct. 9, 1917. Adjustable soldering tip.

1,372,795. TELEPHONE ATTACHMENT; Harry W. Belles, Stewardson, Ill. App. filed March 4, 1920. Disinfectant holder.

1,372,798. METHOD AND APPARATUS FOR MEASURING GAS PRESSURES; Oliver E. Buckley, East Orange, N. J. App. filed Nov. 27, 1918. Measures pressures in vacuum tubes.

1,372,804. CREDIT-SLIP-AUTHORIZING APPARATUS; Herbert G. Dorsey, Gloucester, Mass. App. filed March 2, 1916. Store-service system.

1,372,805. ART OF WELDING; Joseph W. Fay, Milwaukee, Wis. App. filed April 5, 1920. Edges to be welded together spaced apart at all points.

1,372,808. APPARATUS FOR THE PRODUCTION OF INTERMITTENT OR CONTINUOUS HIGH-FREQUENCY OSCILLATIONS; Alphonsus L. Golden, Oakland, Cal. App. filed April 1, 1918. Oscillator of submerged type.

1,372,821. ELECTRIC MEASURING AND CALIBRATING METHOD; Otto A. Knopp, Oakland, Cal. App. filed Nov. 20, 1916. For calibrating or checking meters.

1,372,823. ELECTRIC HEATER; William A. Morrison and Frederick D. Lake, St. Catharines, Ontario, Canada. App. filed Aug. 25, 1919. Heating element quickly removed.

1,372,835. METHOD OF WELDING FLEXIBLE METAL HOSE; Edmund Schroder, Berlin, Germany. App. filed Jan. 13, 1917. Spirally wound metal band.

1,372,850. INDUCTANCE DEVICE; Eugene T. Turney, New York, N. Y. App. filed April 1, 1920. Used for radio signaling.

1,372,851. FLASHLIGHT; George V. C. Vreeland, East Orange, N. J. App. filed Dec. 9, 1919. Economical construction.

1,372,862. TRANSMITTER; Harold J. Carmody, Woodhaven, N. Y. App. filed June 30, 1917. For telephony and dictaphone.

1,372,920. TROLLEY-CONTROLLING MECHANISM; George M. Waterhouse, Sr., New York, N. Y. App. filed Dec. 5, 1918. For retaining trolley pole in position.

1,372,945. COMMUTATOR-INSULATION-TESTING DEVICE; Jasper F. Cullin, Detroit, Mich. App. filed Jan. 22, 1920. Tests insulation between bars.

1,372,950. BATTERY; Robert C. Houston, Greenock, Scotland. App. filed Oct. 23, 1919. Current passes in straight line through all the plates from one terminal to the other.

1,373,002. DYNAMO-ELECTRIC MACHINE; Rudolf E. Hellmund, Swissvale, Pa. App. filed May 16, 1916. System of ventilation.

1,373,007. TROLLEY; Wesley Johnson, Pittsburgh, Pa. App. filed Jan. 14, 1921. Prevents escape of trolley from wire.

1,373,012. ELECTRIC RESISTANCE ELEMENT AND METHOD OF MAKING THE SAME; Ralph E. Marbury, Wilkinsburg, Pa. App. filed March 11, 1919. High resistance for radio work.

1,373,054. ELECTROPERCUSSIVE WELDING; Lewis W. Chubb, Pittsburgh, Pa. App. filed June 9, 1919. Application of heat of relatively great intensity at instant of percussive engagement.

1,373,116. DENTAL WATER HEATER; Elmer W. Bunce, Minneapolis, Minn. App. filed May 22, 1919. Adjustable temperature.

1,373,117. ELECTRIC HEATER; Edmond Delille, Lyon, France. App. filed May 12, 1919. For radiators, flatirons, etc.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

WATERVILLE, ME. — Work will be started at once on the construction of additions to the plant of the Keyes Fibre Company, College Avenue, consisting of a two-story pumping plant and machine works, 45 ft. x 95 ft.; one-story pulp department, 40 ft. x 150 ft.; and a one-story dryer works, 90 ft. x 140 ft. Considerable electrical equipment will be required.

CLARENDON, VT.—Arrangements have been made by the Vermont Hydro-Electric Corporation, Rutland, to increase the output of its generating plant.

NEW BEDFORD, MASS.—Plans have been filed by the Snell & Simpson Biscuit Company, Adams Street, for the erection of a three-story addition to its plant. Electric equipment will be required.

HARTFORD, CONN.—Plans are under consideration by the Hartford Electric Light Company to place its wires underground. Samuel Ferguson is vice-president of the company.

Middle Atlantic States

BINGHAMTON, N. Y.—Arrangements are being made by the Achilles Rubber & Tire Company for the installation of electric equipment providing for an increase in its power load to 2,400 hp. Electric service will be supplied by the Binghamton Light, Heat & Power Company.

MOUNT VERNON, N. Y.—Electrical and mechanical equipment will be installed in the one-story-and-basement addition to be built by the General Optical Company, 256 Washington Street, to cost about $75,000. Bids, it is understood, will be asked in the near future.

NEW YORK, N. Y.—Contract has been awarded to the New York Edison Company by the Frank A. Munsey Company, publisher, for electric service to operate a new plant at Seventh Avenue and Sixteenth Street. The installation, according to present plans provides for 1,600 lamps and about 600 hp. for printing presses, house pumps, etc.

SHARON SPRINGS, N. Y. — A power house will be erected in connection with a number of bath houses and other buildings at the local properties of the J. H. Gardner estate. The cost of the work is estimated at $40,000. Morrill Vroman, 3 North Main Street, Gloversville, is architect and engineer.

MORRISTOWN, N. J. — The Morris & Somerset Electric Company has been granted permission by the Board of Public Utility Commissioners to issue $150,000 in stock, of which about $50,000 will be used for proposed extensions and improvements to its plant and system.

NEWARK, N. J.—The Newark Cleaning & Dye Works will build a power house at its newly acquired plant at 9-13 Beacon Street.

SOUTH AMBOY, N. J.—The Monmouth Lighting Company, under agreement made with the City Council, plans to install new electric lamps in various parts of the city.

BALTIMORE, MD. — Plans are under way for the construction of a power plant to be used in connection with the proposed hospital building at Thirty-third and Berkeley Streets for the Union Memorial Hospital. The total cost is estimated at about $1,000,000. C. L. Reeder, 916 North Charles Street, is engineer.

BALTIMORE, MD.—The Department of Lamps and Lighting contemplates the installation of a new arc-lamp lighting system on a section of Gay Street. John J. Hanson is superintendent.

BALTIMORE, MD. — Considerable electrical equipment will be installed in the steel plant to be built in the Curtis Bay section of Baltimore by the Maryland Steel Rolling Company, to cost about $100,000. J. G. Miller is president of the company.

MOUNT SAVAGE, MD. — Contract has been awarded to Golin Gerlach, Frostburg, by the Mount Savage Fire Brick Company for additions to its plant and a power house, 50 ft. x 90 ft., to cost about $85,000.

CARLISLE, PA.—A movement has been inaugurated by the Chamber of Commerce for a new street-lighting system in Carlisle. Tentative plans are under way for the installation of ornamental lamps on the main thoroughfares.

FARRELL, PA.—F. Whitford Jones, engineer, 1845 Rosalind Avenue, Cleveland, Ohio, has prepared plans for the installation of a lighting system on various streets in Farrell, to cost about $30,000. John Terpack is president of the council.

GARRETT, PA.—The power house, tipple and office of the Consolidated Coal Company, Mine 111, at Althouse, about 2 miles from Garrett, it is reported, has been damaged by fire.

MARTINSBURG, PA.—Application has been made by J. H. Sweet, G. E. and W. B. Simpson for a charter to form a corporation to be known as the Cove Electric Company, to supply electric light, heat and power to Martinsburg and the surrounding community.

PHILADELPHIA, PA.—The construction of a central municipal power plant is contemplated to supply electricity for the city-owned buildings now under construction along the Parkway, including the Art Museum, Free Library and the Municipal Court.

SUNBURY, PA. — The Pennsylvania Power & Light Company is preparing for the construction of a hydro-electric power plant in the vicinity of Sunbury. The proposed plant, with transmission lines to connect with the present system, will cost about $3,000,000.

CAMERON, W. VA.—The Cameron Mining & Development Company is considering the installation of a power plant to supply electricity to the mines and the town of Cameron. The installation of shaft mining machinery is also under consideration.

CHARLESTON, W. VA. — The Georges Creek Coal Company plans to install new machinery at its properties, including electrical apparatus, haulage motors, etc. The company also plans to erect a new tipple. J. M. Harris is secretary and treasurer.

WASHINGTON, D. C.—Bids will be received at the office of A. L. Flint, general purchasing officer of the Panama Canal, Washington, D. C., until April 28 for furnishing electrical supplies and fixtures. (Circular 1443.) Proposal blanks and information may be obtained on application to the above office or at the office of the assistant purchasing officer, 24 State Street, New York City.

North Central States

BACYRUS, OHIO.—Plans are under way for the incorporation of the Scioto Trail Electric Distribution Company, with a capital stock of $10,000, for the erection of an electric transmission line from Bacyrus to Ridgeton, a distance of about 6 miles. The company plans to purchase electricity from the Ohio Power Company. R. M. Mead & Company, electrical engineers, Mansfield, are promoting the work.

BLUFFTON, OHIO. — The Akron, Canton & Youngstown Railway Company, it is reported, plans to install equipment for electrical operation of the Northern Ohio Railroad system, which was recently acquired by the former company.

CLEVELAND, OHIO—The City Council has adopted resolutions providing for replacing gas lamps with electric lamps on part of Worley Avenue, and to install electric lamps on parts of West Thirty-first Place and Maple Court.

COLUMBUS, OHIO.—The City Council is considering an ordinance providing for an appropriation of $110,000 for the purchase of new boiler equipment in the municipal light plant, including the installation of a boiler and stokers to replace two old 300-hp. boilers and revamping of piping to accommodate higher steam pressure.

EAST ST. LOUIS, ILL.—The Dependable Truck & Tractor Company, 231 Collinsville Street, has plans under way for the construction of a new plant, including a main building, 100 ft. x 250 ft., and a power plant, to cost about $250,000 with equipment. Riester & Rubach, Murphy Building, are architects. C. V. Morse is president.

URBANA, ILL. — Improvements to the street-lighting system, including the installation of ornamental lamps, are under consideration. Electric service is furnished by the Urbana Light, Heat & Power Company.

MILWAUKEE, WIS.—Plans have been prepared by T. C. Hatton, engineer, for the erection of electric power plants to cost $2,000,000. J. H. Fowles, City Hall, is secretary.

TWO RIVERS, WIS. — The Wisconsin Textile Manufacturing Company plans to erect a new plant, 60 ft. x 180 ft., with a separate power house and dry kiln. The company is increasing its capital stock from $50,000 to $150,000 to provide for the new construction and equipment.

CEDAR RAPIDS, IOWA.—Improvements to the lighting system, including the substitution of the present 60-cp. lamps for 100-cp. lamps, are under consideration. Electric service is furnished by the Iowa Railway & Light Company.

CLARINDA, IOWA.—The erection of a municipal electric plant in Clarinda is under consideration. Dr. C. B. Eller of the Clarinda Community Club is interested.

NEW HAVEN, MO. — Bonds to the amount of $14,000 have been voted for extensions to the electric light and water systems.

CHANUTE, KAN.—The Ash Grove Lime & Portland Cement Company, Grand Avenue Temple Building, Kansas City, Mo., has had plans prepared by the Lehrach Engineering & Construction Company, 412 American Bank Building, Kansas City, Mo., for the erection of a power plant to cost about $100,000.

Southern States

HAMILTON, N. C.—Arrangements are being made for an issue of $10,000 in electric light bonds.

HICKORY, N. C.—Permission has been granted to the United Mills Company by the Federal Power Commission to construct a hydro-electric power plant at Harpers Creek, to be used in connection with the operation of its textile mills.

BARWICK, GA. — Electric light and water bonds to the amount of $11,000 have been voted.

DELAND, FLA.—The Deland Electric Light, Power & Ice Company plans to install a 500-kw. direct-connected turbine, condenser, spray pond, piping and two 300-hp. water-tube-type boilers. E. L. Hon is general manager.

NEW AUGUSTINE, FLA. — Steps have been taken by the New Augustine Progressive League to secure a complete lighting system for this city. Estimate of the cost of installing the proposed system has been submitted by the St. Johns Electric Company, St. Augustine.

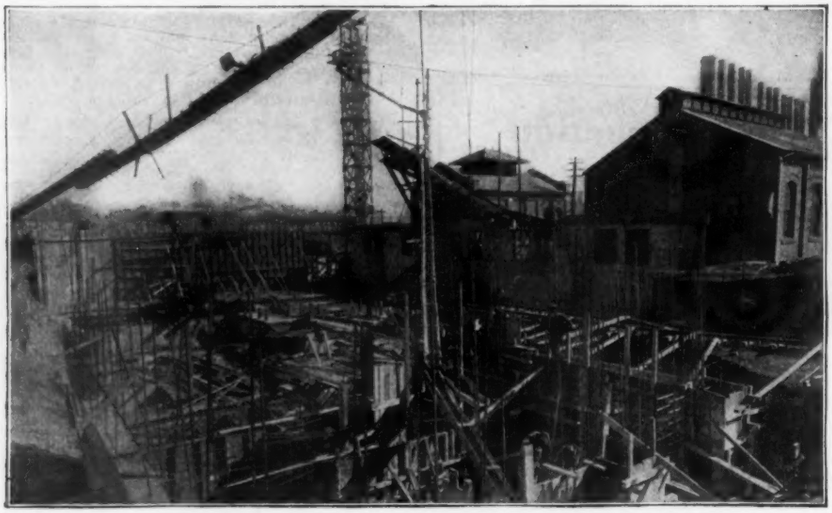
TALLAHASSEE, FLA.—The installation of an ornamental lighting system in Tallahassee is under consideration. The initial installation would include sixty lamps on Monroe and Adams Streets. Aaron Levy is interested.

MEMPHIS, TENN.—At an election to be held May 19 the proposal to issue $10,000,000 in bonds for the purchase or erection of a municipal gas and electric light plant will be submitted to the voters.

MUSKOGEE, OKLA.—Preliminary surveys have been completed for the proposed interurban car lines to connect Oklahoma City with Henryetta, Okmulgee and Muskogee. Present plans, it is reported, include the erection of a large power plant from which it is proposed to supply electric power to practically all cities in the eastern and central parts of Oklahoma. R. D. Long, Muskogee, is promoting the project.

SAND SPRINGS, OKLA. — The Sand Springs Home has applied to the Federal Power Commission for authority to erect a dam, 42 ft. high, in the Grand River, to develop about 25,000 hp.

STEPHENVILLE, TEX. — The Texas Light & Power Company is considering extensions to the local electric lighting system.



PUEBLO (COL.) STEAM PLANT OF ARKANSAS VALLEY RAILWAY, LIGHT & POWER COMPANY

Extensive additions being made to accommodate 35,000 hp. With other improvements under way the construction expenditure will be more than $1,000,000

Pacific and Mountain States

TACOMA, WASH.—A resolution has been introduced in the City Council by Ira S. Davisson, commissioner of light and water, providing for the installation of an ornamental lighting system on downtown streets running east and west from Eighth to Seventeenth Street.

VANCOUVER, WASH.—The Northwestern Electric Company, Portland, it is understood, will apply for a franchise to operate in Vancouver. The present plans also provide for an expenditure of $50,000 for construction in southern Washington. The company, it is reported, plans early construction of a power plant on the north fork of the Lewis River at Yale, to develop 25,000 hp. The cost of this project is estimated at $5,000,000.

PORTLAND, ORE.—Contracts will be awarded soon for the construction of a dam, power plant and screen house at the headworks of the Bull Run water reserve. Fred Randlett is chief engineer of the Water Bureau.

LOS MOLINOS, CAL.—The Pacific Gas & Electric Company contemplates extending its lines through the Los Molinos colony. The cost is estimated at about $5,000. H. B. Heryford is manager of the west side division of the company.

SAN FRANCISCO, CAL.—Dudley Moulton has applied for permission to divert 3,000 cu.ft. per second from the Klamath River for power purposes. Present plans provide for the erection of a dam, 900 ft. long, and the development of 60,000 hp. The cost of the project is estimated at $2,000,000.

MYTON, UTAH.—The Uintah Power & Light Company has applied to the Federal Power Commission for permission to construct a small diversion dam in the Uintah River, Duchesne County, a 5-mile conduit to forebay, a 1-mile penstock to power house on the Uintah River, a diversion dam in Pole Creek and a 2-mile conduit leading to the above-mentioned forebay, to develop 6,500 hp. Arrangements have also been made by the stockholders of the company to issue $150,000 in bonds, the proceeds to be used to pay off indebtedness and for additions to the plant and equipment.

SALT LAKE CITY, UTAH.—Thomas J. Davis, Watson, has applied to the State Engineer for permission to appropriate 20 cu.ft. of water from the White River, Uintah County, for the development of electrical energy for various purposes.

SALT LAKE CITY, UTAH.—The Sevier River, Land & Water Company, Lynndyl, has applied to the State Engineer for permission to divert 200 sec.ft. of water from the Sevier River for the development of 3,000 hp. of electrical energy to supply Lynndyl, Eureka and surrounding country. The present plans, it is understood, provide for the erection of a dam, headgate, measuring device, spillway, canal, installation of three turbine wheels, etc.

IDAHO FALLS, IDAHO.—The installation of two new 500-kw. units to replace two old 300-kw. units at the municipal power plant is contemplated by the City Council.

LIVINGSTON, MONT.—The installation of an ornamental lighting system is under consideration. Electric service is supplied by the Montana Power Company.

CHEYENNE, WYO.—William Kyne of Casper has applied for permission to erect a transmission line from Boysen Dam to Casper, a distance of 130 miles, to cost about $350,000.

COLORADO SPRINGS, COL.—The Condon Engineering Company, Harris Trust Building, Chicago, Ill., has assumed management of the Intermountain Railway, Light & Power Company and contemplates improvements to the system to cost about $400,000.

DENVER, COL. — The Denver Gas & Electric Light Company has made arrangements for an issue of $1,000,000 in bonds, part of the proceeds to be expended for extensions and improvements to its electric plants. Frank W. Frueauff is president.

CLOVIS, N. M.—The installation of additional equipment, to cost about $100,000, at the municipal power plant is under consideration.

Canada

TORONTO, ONT.—Petition will be made to the City Council by Ward Eight for improvements to the street lighting on East Queen Street in the Beaches district.